This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

B 427157

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 73.

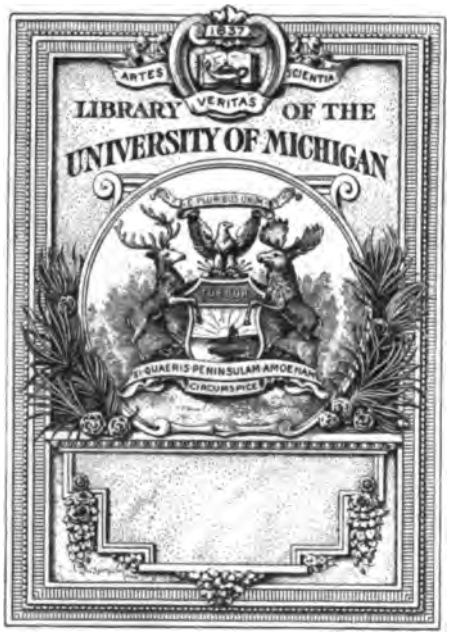
SEMI-ANNUAL MEETING.

Held in Hall of The American Society of Mechanical Engineers,
12 West Thirty-First Street, New York, N. Y.,

SEPTEMBER 30 and OCTOBER 1-2, 1902.

Office of the Association:
Room 37, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY.
1902



THE GIFT OF
Association

TS
1550
.N2

NEW ENGLAND

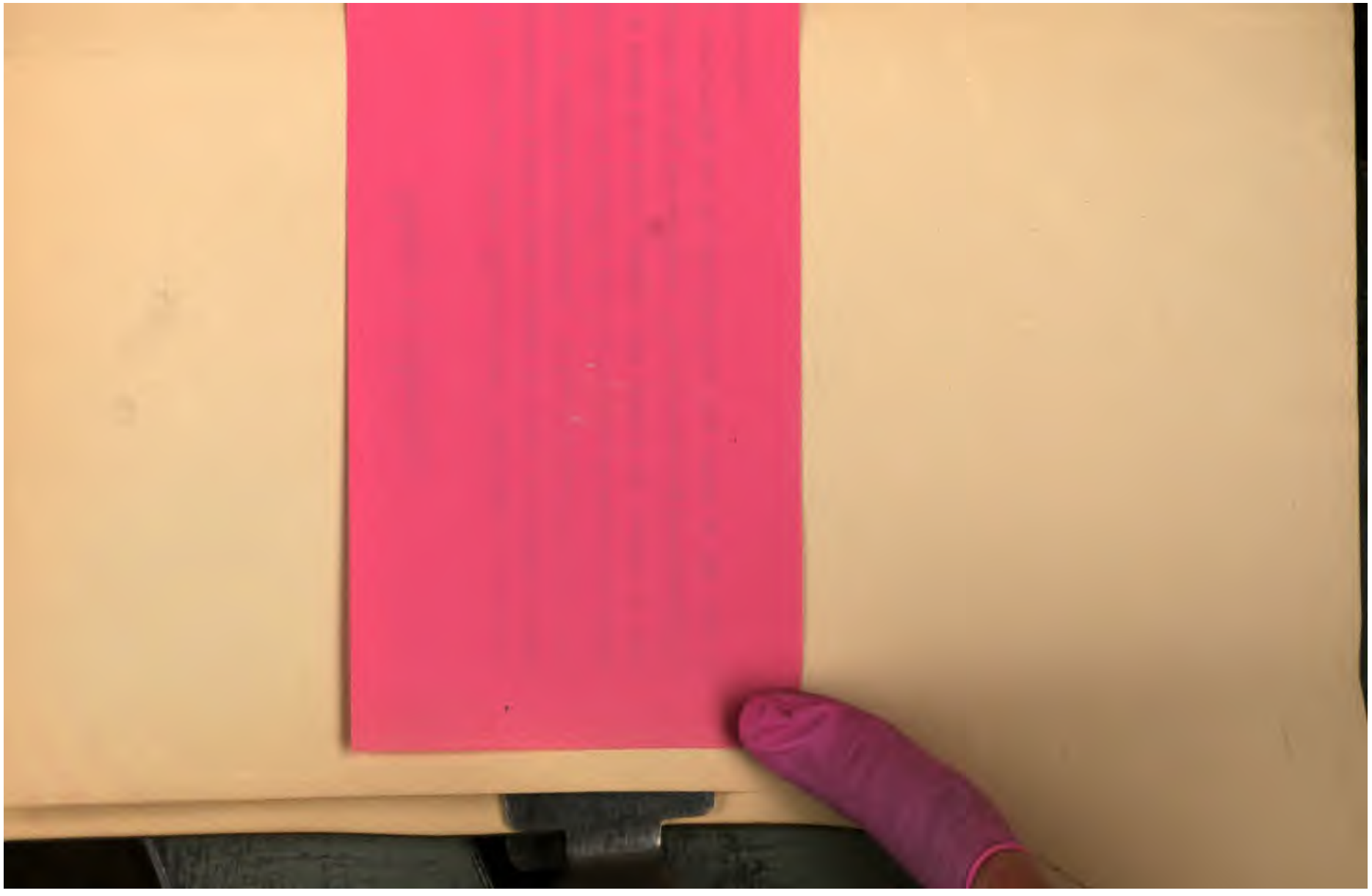
Cotton Manufacturers' Association.

Proposal for

Membership of

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body it must include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.



NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

Membership of

Application Received

.....190 .

Action by Board of Government, ... *favorable.*

.....190 .

Voted by the Association, ... *elected.*

.....190 .

New England Cotton Manufacturers' Association.

Room 57, International Trust Building,

45 MILK STREET,

BOSTON, MASS.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. . . . . . .

Position, ...

P. O. Address, ...

is proposed for . . . . . *membership in the* NEW ENGLAND COTTON
active or associate

MANUFACTURERS' ASSOCIATION *by* . . . . . .
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full, particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 190 .

. . . . . .
signature of candidate.

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 73.

SEMI-ANNUAL MEETING.

Held in Hall of The American Society of Mechanical Engineers,
12 West Thirty-First Street, New York, N. Y.,

SEPTEMBER 30 and OCTOBER 1-2, 1902.

Office of the Association:
Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY,
1902.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1902
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

NOW, THEREFORE, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

15703

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1902.

PRESIDENT.

CHARLES H. FISH, ... Dover, N. H.

VICE-PRESIDENTS.

HERBERT E. WALMSLEY, . . . New Bedford, Mass
ALFRED E. ADAMS, ... Whitinsville, Mass.

DIRECTORS.

WILLIAM D. HARTSHORNE, . . Lawrence, Mass.
JAMES R. MacCOLL, ... Pawtucket, R. I.
J. R. MONTGOMERY, ... Windsor Locks, Conn
WILLIAM D. PENNELL, ... Lewiston, Me.
W. B. SMITH WHALEY, ... Columbia, S. C.
GEORGE F. WHITTEN, . . . Manchester, N. H.

AUDITOR.

C. E. ROBERTS, ... Boston, Mass.

SECRETARY AND TREASURER.

C. J. H. WOODBURY, P. O. Box 3672, Boston, Mass.

OFFICE OF THE ASSOCIATION:

Room 57, International Trust Building, 45 Milk Street, Corner of Devonshire Street, Boston, Mass.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Edw. W. Thomas,	1894–95
Amos D. Lockwood,	1878–80	A. M. Goodale,	1895–96
John Kilburn,	1880–83	Arthur H. Lowe,	1896–97
William C. Lovering,	1883–85	Russell W. Eaton,	1897–98
Richard Garsed,	1885–86	Stephen A. Knight,	1898–99
J. S. Ludlam,	1886–88	Frederick E. Clarke,	1899–99
Henry F. Lippitt,	1888–89	D. M. Thompson,	1900–01
Walter E. Parker,	1889–92	CHARLES H. FISH,	1901–
Robert McArthur,	1892–94		

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Robert McArthur,	1889–92
William A. Burke,	1865–73	Simeon B. Chase,	1891–93
John C. Palfrey,	1873–76	E. W. Thomas,	1892–94
Edward Atkinson,	1876–78	A. M. Goodale,	1893-95
A. G. Cumnock,	1877–80	William J. Kent,	1894–97
Charles Nourse,	1878–81	Fred. C. McDuffie,	1895–00
William F. Goulding,	1880–83	Henry T. Whitin,	1897–00
Richard Garsed,	1881–85	C. H. Richardson,	1900–01
J. S. Ludlam,	1883–86	George H. Hills,	1900–02
Walter E. Parker,	1885–89	H. E. WALMSLEY,	1901–
Richard B. Borden,	1886–88	ALFRED E. ADAMS,	1902–
Arnold B. Sanford,	1888–91		

DIRECTORS.

J. S. Davis,	1865–69	William P. Haines,	1874–78
Charles Nourse,	1865–78	S. S. Spencer,	1887–90
Phineas Adams,	1865–74	E. W. Thomas,	1888–92
William P. Haines,	1865–69	William W. Whitin,	1888–93
Thomas J. Borden,	1865–78	Robert R. Smith,	1889–92
Daniel D. Crombie,	1865–68	Alfred M. Goodale,	1890–93
A. M. Wade,	1868–69	William J. Kent,	1891–94
D. J. Johnston,	1869–70	Herman F. Straw,	1891–93
F. E. Clarke,	1869–75	Fred C. McDuffie,	1892–95
A. G. Cumnock,	1869–77	George W. Bean,	1892–95
Cyrus I. Barker,	1875–80	F. M. Messenger,	1893–95
Hervey Kent,	1877–81	Albert F. Knight,	1893–99
David J. Johnston,	1878–82	Arthur H. Lowe,	1894–96
Walter Paine, 3d,	1878–80	Henry T. Whitin,	1894–97
Chas. L. Lovering,	1878–83	Herbert L. Pratt,	1895–98
Richard Garsed,	1880–81	Stephen A. Knight,	1895–98
William H. Jennings,	1880–83	John Eccles,	1895–99
Chas. D. McDuffie,	1881–83	Russell W. Eaton,	1896–97
Walter E. Parker,	1881–85	C. H. Richardson,	1897–00
John W. Danielson,	1881–85	George H. Hills,	1897–00
William E. Barrows,	1882–83	John T. Meats,	1898–01
Rufus A. Maxfield,	1883–86	Alfred E. Adams,	1899–02
George W. Weeks,	1883–86	A. Tenny White,	1899–02
Henry S. Howe,	1883–87	Charles H. Fish,	1900–01
Richard B. Borden,	1883–86	Herbert E. Walmsley,	1900–01
O. S. Brown,	1885–91	GEO. F. WHITTEN,	1898–
Henry F. Lippitt,	1885–88	W. B. SMITH WHALEY,	1901–
Wilbur A. Stiles,	1886–88	Wm. D. HARTSHORNE,	1901–
Robert McArthur,	1886–89	JAMES R. MacCOLL,	1901–
Stephen N. Bourne,	1886–91	J. R. MONTGOMERY,	1902–
John Kilburn,	1870–80	WM. D. PENNELL,	1902–

AUDITORS.

BENJAMIN SAUNDERS,	1865–71	J. HERBERT SAWYER,	1882–00
JOHN C. PALFREY,	1871–73	C. E. ROBERTS,	1900–
HENRY D. SULLIVAN,	1873–82		

SECRETARY AND TREASURER.

AMBROSE EASTMAN,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

Oct. 2, 1902.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

George Arms	Grand Hotel	New York City	Oct. 16, 1872.
Ambrose Eastman	53 State St., Room 904,	Boston, Mass.	Sept. 27, 1894.
Henry Smith Pritchett, LL.D.,	Pres. Mass. Institute of Technology,	Boston, Mass.	Sept. 26, 1901.
Samuel Webber	Hydraulic Engineer	Charlestown, N. H.	Apr. 20, 1865.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills / Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co. 120 Commercial St.,	Adams, Mass.	Apr. 29, 1896.
Joseph D. Aiken	Asst. Supt. Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co. Box 34,	Providence, R. I.	Apr. 28, 1886.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co., Box 83, 47 Charles St.,	Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co. 70 Kilby St.,	Boston, Mass.	Apr. 25, 1894.
Frederic Amory	Treas. Nashua Mfg. Co. and Jackson Mfg. Co. Room 51, Simmons B'l'd., 40 Water St.,	Boston, Mass.	Apr. 27, 1899.

Thomas Armstrong	Supt. No. Pownal Mfg. Co.	No. Pownal, Vt.	Oct. 28, 1897.
Abel T. Atherton	Machine Maker	Bay Side, R. I.	Oct. 16, 1872.
Edward Atkinson	Prest. Boston Mfrs. Mu. Fire Ins. Co.	31 Milk St., Boston, Mass.	Apr. 19, 1871.
E. W. Atkinson	Stoddard, Haserick, Richards & Co.	152 Congress St., Boston, Mass.	Oct. 27, 1886.
H. C. Atwood	Treas. Williamsville Manufg. Co.	Providence, R. I.	Apr. 29, 1885.
James A. Atwood	Agt. Wauregan Co. and Quinebaug Co.	Wauregan, Conn.	Oct. 28, 1891.
John Walter Atwood	Supt. Wauregan Co.	Wauregan, Conn.	Oct. 25, 1895.
W. E. Atwood	Secy. and Asst. Treas. Williamsville Manufg. Co.	Killingly, Conn.	Sept. 27, 1894.
George A. Ayer	Supt. West Boylston Co.	Easthampton, Mass.	Apr. 24, 1895.
Nathaniel F. Ayer	Asst. Mgr. Farwell Bleachery	56 Summer St., Boston, Mass.	Apr. 25, 1901.
G. H. T. Babbitt	Asst. Supt. Chicopee Mfg. Co.	Chicopee, Falls, Mass.	Oct. 2, 1902.
Henry A. Bailey	Agt. Chicopee Manufg. Co.	Chicopee Falls, Mass.	Oct. 25, 1893.
Dickerson G. Baker	Mech. Eng., American Thread Co.	P. O. Box B, Willimantic, Conn.	Oct. 18, 1900.
Edwin H. Baker	Bliss, Fabyan & Co., Box 2899	117 Duane St., New York City, N. Y.	Apr. 24, 1878.
Edward R. Ballou	Treas. Ballou Yarn Co.,	189 Charles St., Providence, R. I.	Apr. 25, 1894.
William P. Bancroft	Vice-Pres. Joseph Bancroft & Sons Co.	Wilmington, Del.	Oct. 31, 1883.
Louis B. Barker	Agt. United States Cotton Co.	Central Falls, R. I.	Apr. 27, 1899.
V. T. Barber	Supt. Slater Cotton Co.	Pawtucket, R. I.	Oct. 2, 1902.
Lewis E. Barnes	Agt. Pemberton Co. & Methuen Co.,	Methuen, Mass.	Oct. 25, 1895.
William A. Barrell	Agt. Lawrence Duck Co.	Lawrence, Mass.	Apr. 30, 1884.
Thomas Barrett, Jr.	Pres. Langley & Aiken Mills	Augusta, Ga.	Apr. 26, 1900.
Edwin N. Bartlett	Supt. Sigourney and Rockdale Mills,	North Oxford, Mass.	Apr. 29, 1891.
Daniel Moore Bates	Asst. Supt. Joseph Bancroft & Sons Co.,	Rockford, Wilmington, Del.	Apr. 27, 1898.
Joseph P. Battles	Crompton & Knowles Loom Works,	Worcester, Mass.	Oct. 25, 1895.
Edward C. Beach	Supt. Gate City Cotton Mills	East Point, Georgia	Oct. 5, 1899.
C. Enos Bean	Supt. Millville Mfg. Co.	Millville, N. J.	Apr. 24, 1902.
George W. Bean	Agt. Androscoggin Mills	Lewiston, Me.	Apr. 17, 1872.
Robert Beatty	Robert Beatty & Co.	Coral and Adams Sts., Philadelphia, Pa.	Oct. 28, 1897.
Truman Beckwith	Treas. Dyerville Manufg. Co.	610 Manton Ave., Providence, R. I.	Apr. 27, 1892.
John W. Bell	Asst. Treas. Smith & Dove Manufg. Co.	Andover Mass.	Oct. 28, 1897.
A. C. Bent	Agt. Safety Seamless Pocket Co.	Taunton, Mass.	Oct. 28, 1897.

William H. Bilbrough	Mgr. Elmira Knitting Mills and Mgr. Conewawah Spinning Co.	Elmira, N. Y.	Apr. 24, 1902.
W. N. Blackstone	Treas. Attawaugan Co. Treas Totokett Mills Co	Norwich, Conn.	Apr. 29, 1896.
Wm. Washington Blades,	Gen. Supt. Lorraine Mfg. Co.	135 Mineral Spring Ave., Pawtucket, R. I.	Oct. 25, 1893.
T. Ashby Blythe	Proprietor Ashby Cotton Mills	114 Chestnut St., Philadelphia, Pa.	Oct. 28, 1897.
John P. Bodge	Treas. Arkwright Mills	Fall River, Mass.	Oct. 28, 1897.
Jefferson Borden, Jr.	Supt. Fall River Bleachery Co.	Fall River, Mass.	Apr. 21, 1869.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 19, 1865.
Thomas J. Borden	326 North Main St.	Box 118, Fall River, Mass.	Apr. 20, 1865.
E. S. Boss	Agt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
A. E. Bosworth	Supt. Bernon Mills	Georgiaville, R. I.	Oct. 2, 1902.
Henry Deane Bourne	Treas. Hooksett Mfg. Co., 1741 Elm St.	Manchester, N. H.	Oct. 18, 1900.
Stephen N. Bourne	Agt. Dundee Mills	Hooksett, N. H.	Oct. 21, 1868.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen Mills,	Riverpoint, R. I.	Oct. 25, 1895.
A. W. Brainerd	Gen. Mgr. Millville Mfg. Co. and May's Landing Water Power Co.	Millville, N. J.	Apr. 27, 1898.
S. Parker Bremer	Treas. Monadnock Mills	4 Winthrop Sq., Boston, Mass.,	Oct. 2, 1902.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
George T. Briggs,	Vice-Pres. and Gen. Mgr. The Briggs Mfg. Co.	Voluntown, Conn.,	Apr. 24, 1902.
Christopher P. Brooks	Managing Director New Bedford Textile School	New Bedford, Mass.	Apr. 28, 1897.
Henry R. Brown	Supt. Phenix Mill	Box 56, Phenix, R. I.	Apr. 28, 1897.
Isaac A. Brown	Treas. Narragansett Mills	Box 324, Fall River, Mass.	Sept. 29, 1898.
James W. Brown		P. O. Box 312, Ipswich, Mass.	Oct. 15, 1873.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
Thomas J. Brown	George Brown's Sons	Mt. Joy, Penn.	Oct. 28, 1897.
E. C. Bucklin	Treas. Interlaken Mills	Butler's Exchange, Box 289, Providence, R. I.	Apr. 25, 1883.
Robert Burgess	Treas. Slater Cotton Co.	Pawtucket, R. I.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 28, 1880.
Alfred H. Burnham	Mgr. Glasgow Mills, Station Kensington	Huntington and Jasper Sts., Philadelphia, Pa.	Apr. 26, 1900.
Hervey Burnham	Supt. Beaver Mills and Eclipse Mill	270 East Main St., North Adams, Mass.	Apr. 27, 1899.
W. R. Burnham		Norwich, Conn.	Apr. 29, 1885.

William D. Cadwell, . . Agt. Nashua Mfg. Co., ... 67 Concord St., Nashua, N. H. . . . Apr. 19, 1871.
William H. Cadwell . . Agt. Jackson Company . . . . . Nashua, N. H. . . . Apr. 26, 1900.
John P. Campbell . . . Supt. New York Mills, New York Mills, Oneida Co., N. Y., Sept. 22, 1896.
Byron F. Card . . . . . 300 Chestnut St., Philadelphia, Pa. . . . Apr. 25, 1888.
Samuel A. Carter . . . Pres. Gate City Cotton Mills . . . . Atlanta, Ga. . . . . Sept. 26, 1901.
George A. Chace . . . Treas. Bourne Mills . . . . . Fall River, Mass. . . . Apr. 25, 1877.
John W. Chafee . . . Pres. and Treas. The Sibley Mfg. Co. Augusta, Ga. . . . . Oct. 18, 1900.
Simeon B. Chase . . . Treas. King Philip Mills . . . . . Fall River, Mass. . . . Apr. 21, 1875.
Clarence N. Childs . . Asst. Supt. Hamilton Manufg. Co. . . . . 43 Pine St., Lowell, Mass. . . . Apr. 24, 1895.
Elmer G. Childs . . . Agt. Boston Duck Co. . . . . Bondsville, Mass. . . . Oct. 26, 1892.
Jno. H. C. Church . . . Asst. Treas and Sec. Monument Mills, Gt. Barrington, Mass. Apr. 28, 1897.
Ernest E. Clark . . . Mech. Supt. Montreal Cotton Co. . . . Valleyfield, P. Q. . . . Apr. 29, 1896.
E. N. Clemence . . . Sec. and Treas. Eagle & Phenix Mills Columbus, Ga. . . . Apr. 28, 1897.
W. H. Cloher, Jr. . . . Treas. and Agt. Utica Cotton Co. Capron, Oneida Co., N. Y., Sept. 22, 1896.
Josiah G. Coburn . . . . . 99 Washington St., Newton, Mass. . . . Apr. 20, 1865.
Charles H. Collins . . Supt. Berkeley Co. . . . . Ashton, R. I. . . . . Apr. 26, 1900.
John A. Collins . . . . Supt. American Linen Co. . . . . 73 Cottage St., Fall River, Mass. . . Oct. 31, 1883.
B. B. Comer . . . . . Pres. and Treas. Avondale Cotton Mills . . . . . Birmingham, Ala. . . . Apr. 26, 1900.
Frank B. Comins . . . Treas. American Moistening Co. . . . . 150 Devonshire St., Room 67, Boston, Mass. . . . . Oct. 28, 1891.
Caesar Cone . . . . . Pres. Proximity Mfg. Co. . . . . Greensboro, N. C. . . Apr. 26, 1900.
John J. Connell . . . . Agt. Tremont & Suffolk Mills . . . Lowell, Mass. . . . Apr. 27, 1892.
Halsey Connett . . . . Supt. Clark Mile End Spool Cotton Co. East Newark, N. J. . Oct. 2, 1902.
Sidney Coolidge . . . Treas. Stark Mills, 50 State St., Room 17 . . . . . Boston, Mass. . . . Sept. 26, 1901.
Peter H. Corr . . . . Treas. Greenwich Bleachery . . . . Taunton, Mass. . . . Apr. 24, 1895.
Frank H. Cotton . . . Mgr. Hope Mills Mfg. Co. . . . Hope Mills, N. C. . . Apr. 27, 1899.
Lyman M. Cousens, . . Pres. Dana Warp Mills . . . . . Portland, Me. . . . Apr. 24, 1902.
Alphonse S. Covel . . Treas. Tremont and Suffolk Mills, ... P. O. Box 1716, 70 Kilby St., Boston, Mass. . . . Oct. 31, 1877.
Richard Cowell . . . . Supt. Boott Cotton Mills, 25 Read St., Lowell, Mass. . . . Apr. 24, 1902.
William W. Crapo . . Pres. Wamsutta Mills . . . . . New Bedford, Mass. . Sept. 29, 1898.
William J. Cray . . . Supt. Aldrich Mfg. Co. . . . . Moosup, Conn. . . . Apr. 25, 1901.
P. T. Creed . . . . . Agt. Hopewell Mills . . . Box 356, Taunton, Mass. . . . Sept. 22, 1896.
John B. Cudlip . . . . Mgr. Cornwall & York Cotton Mills Co. . . . . St. John, N. B. . . . Apr. 28, 1897.
H. H. Culver . . . . . Supt. Elizabeth Poole Mills . . . . . 39 Ashland St., Taunton, Mass. . . . Apr. 28, 1897.
Henry S. Culver . . . Supt. Westville Cotton Mills . . . . Taunton, Mass. . . . Apr. 28, 1897.
A. G. Cumnock . . . . Treas. Appleton Co. . . . Box 2284, Lowell, Mass. . . . July 19, 1865.
Andrew J. Currier . . Supt. Cohannet & Nemasket Mills . Taunton, Mass. . . . Apr. 25, 1888.

T. B. Dallas	Treas. Dallas Manufg. Co. Box 386,	Nashville, Tenn.	Oct. 25, 1895.
Philip Dana	Supt. Dana Warp Mills	Westbrook, Me.	Sept. 29, 1898.
Woodbury K. Dana	Treas. Dana Warp Mills	Westbrook, Me.	Apr. 25, 1888.
Albert W. Danforth	Mech. Eng. Shanghai Cot. Cloth Mills, Shanghai, China	881 Bridge St., Lowell, Mass.	Apr. 27, 1881.
A. Lockwood Danielson	Asst. Treas. Quinebaug Co., Box 900,	Providence, R. I.	Sept. 27, 1894.
J. DeForest Danielson	Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works	Providence, R. I.	Sept. 27, 1894.
John W. Danielson	Treas. Lockwood Co. and Ponemah Mills	Box 900, Providence, R. I.	July 15, 1868.
Bradford D. Davol	Pres. Barnard Mfg. Co.	P. O. Box 418, Fall River, Mass.	Apr. 25, 1877.
Albert Deabill	Supt. Lowell Hosiery Co., Mt. Vernon St.	Lowell, Mass.	Apr. 25, 1901.
Augustus De Cort	Treas. Beacon Mfg. Co.,	P. O. Box 2815 Boston, Mass.	Apr. 26, 1900.
George DeForest	Treas. Utica Steam Cotton Mills	Utica, New York	Oct. 28, 1897.
William P. Dempsey	Treas. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Vice Pres. and Agt. Johnson-Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny	Pres. American Card Clothing Co.	Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Treas. Pepperell Mfg. Co.	30 Kilby St., Boston, Mass.	Apr. 29, 1896.
Charles Owen Dexter	Mgr. Canadian Colored Cotton Mills Co. Ltd.	Hamilton, Ont., Can.	Apr. 24, 1895.
Henry C. Dexter,	Agt. and Sec. Greene & Daniels Mfg. Co.	Pawtucket, R. I.	Apr. 25, 1901.
Lewis Dexter, Jr.	Mgr. The Canadian Colored Cotton Mills Co., Ltd.	Milltown, N. B.	Apr. 27, 1899.
F. Dilling	Pres. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 25, 1895.
Albert W. Dimick	Supt. Fisher Mfg. Co.	Fisherville, Mass.	Apr. 25, 1894.
Bradford C. Divine	Supt. Utica Willowvale Bleaching Co.	Chadwicks, N. Y.	Apr. 27, 1899.
Robert Dow,	Partner in Solway Mills,	Westerly, R. I.	April 25, 1901.
Eben S. Draper	Agt. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Treas. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Sec'y Draper Co.	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Pres. Draper Co.	Hopedale, Mass.	July 17, 1867.
William F. Draper, Jr.	Draper Co.	Hopedale, Mass.	Oct. 29, 1890.
Harry K. Drew	Supt. Clinton Mfg. Co.,	93 Clinton St., Woonsocket, R. I.	Apr. 24, 1902.
O. D. Drew	Supt. Peabody Manufacturing Co.	Newburyport, Mass	Oct. 2, 1902.
James B. Duggan	Pres. Union Bleaching and Finishing Co.	41 Jewett Place, Utica, N. Y.	Oct. 2, 1902.
Frederic C. Dumaine,	Treas. Amory Mfg. Co., Box 2879	64 Ames Building, Boston, Mass.	April 25, 1901.
T. C. Duncan	Pres. and Treas. Union Cotton Mills	Union, S. C.	Apr. 26, 1900.
Joseph M. Dunham		43 Edwards St., Springfield, Mass.	Oct. 26, 1892.
Frank J. Dutcher	Pres. Shaw Stocking Co.	Hopedale, Mass.	Apr. 24, 1902.
Frank H. Dwelly	Treas. Tecumseh Mills	Fall River, Mass.	Apr. 27, 1899.
David H. Dyer	D. H. Dyer & Son, Mill Engineers, P. O. Box 582,	6, 7 and 8 Pocassett Bank Building, Fall River, Mass.	Oct. 18, 1871.

Benjamin M. Earle	Prop. Merchants Dye Works	Walnut Hill, Mass.	Sept. 26, 1901.
Wm. Ambrose Eastman,	Treas. Lowell Hosiery Co.	Lowell, Mass.	Apr. 24, 1878.
Russell W. Eaton	Agt. Cabot Manufg. Co.	Brunswick, Me.	Oct. 27, 1887.
John Eccles	Agt. Ponemah Mills	Taftville, Conn.	Apr. 27, 1892.
Lawrence V. Elder	Man. Dir. Galveston City Cotton Mills	212 Tremont St., Galveston, Texas	Oct. 27, 1886.
Oscar Elsas	Vice-Pres. Fulton Bag & Cotton Mills,	P. O. Box 773, Atlanta, Ga.	Apr. 28, 1897.
Frederick W. Ely	Agt. Columbian Manufg. Co.	Greenville, N. H.	Apr. 25, 1888.
H. B. Estes	Agt. Continental Mills	Lewiston, Me.	Apr. 26, 1893.
William Evans	Treas. Wampanoag Mills	Fall River, Mass.	Apr. 29, 1896.
D. A. Everly	Cotton Mfr.	Pawtucket, R. I.	Apr. 24, 1902.
Charles F. Farrar		22 Coggeshall St., Fall River, Mass.	Oct. 28, 1897.
George E. Farrell	Treas. Utica Spinning Co.	Utica, N. Y.	Oct. 18, 1900.
James T. Ferguson	Supt. Warwick Mills	Centreville, R. I.	Oct. 5, 1899.
Frank S. Field	Supt. & Agt. Massaemit Yarn Mills	Shattuckville, Mass.	Oct. 25, 1895.
William Firth	Pres. American Moistening Co. & Wm. Firth Co.	P. O. Box 1460, 150 Devonshire St., Room 67, Boston, Mass.	Apr. 25, 1888.
Charles H. Fish	Agt. Cocheco Manufg. Co.	Dover, N. H.	Apr. 27, 1887.
Charles W. Fisher,	Asst. Supt. Fisher Mfg. Co.	Fisherville, Mass.	Apr. 25, 1901.
Henry E. Fisher	Vice-Pres. & Agt. Atlanta Cotton Mills	Atlanta, Ga.	Oct. 25, 1895.
Herbert Fisher		Taunton, Mass.	Oct. 29, 1879.
William B. Fittz		Easthampton, Mass.	Oct. 26, 1892.
Frederick A. Flather	Supt. McCormick Harvesting Machine Co.	Blue Island and Western Ave., Chicago, Ill.	Apr. 29, 1891.
F. C. Fletcher	Vice Pres. Lawton Spinning Co.	621 Banigan Building, Providence, R. I.	Oct. 18, 1900.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Philip H. Fowler	417 Monmouth St.,	Gloucester City, N. J.	Nov. 30, 1881.
Edward W. France	Dir. of Philadelphia Textile School,	320 So. Broad St., Philadelphia, Pa.	Sept. 22, 1896.
Arthur C. Freeman	Agt. Rusden Machine Co.	39-41 Cortlandt St., Room 8, New York, N. Y.	Apr. 27, 1899.
John W. Fries	Managing Partner, F. & H. Fries,	Winston-Salem, N. C.	Oct. 18, 1900.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
W. T. Galey	Pres. Aberfoyle Manufg. Co.	Chester, Pa.	Apr. 28, 1897.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
James G. Garland		Saco, Me.	Oct. 29, 1879.
Edward T. Garsed	Supt. Pell City Mfg. Co.	Pell City, Ala.	Apr. 27, 1898.
Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford	Philadelphia, Pa.	Oct. 28, 1897.
James A. Gary	Alberton Mills	108 German St., Baltimore, Md.	Apr. 25, 1883.
James Gee	Supt. Interlaken Dye Works	Fiskville, R. I.	Apr. 27, 1898.

Charles E. Getchell	35 Willow St.,	Waltham, Mass.	Oct. 30, 1889.
William C. Godfrey	Agt. Indian Orchard Co.	Indian Orchard, Mass.	Oct. 29, 1890.
Otto Goetze,	Partner and Gen. Mgr. Glasgow Mills	Philadelphia, Pa.	Apr. 24, 1902.
Alfred M. Goodale	Treas. Boston Manufg. Co. 50 State St.,	Boston, Mass.	Apr. 25, 1883.
Louis B. Goodall	Treas. Goodall Worsted Co.	Sanford, Me.	Oct. 5, 1899.
Frederick B. Gordon	Pres. Columbus Mfg Co.	Columbus, Ga.	Apr. 26, 1900.
Charles H. Gorton	Supt. Columbus Mfg. Co.	Columbus, Ga.	Apr. 25, 1894.
Marcellus Gould	Pres. and Mgr. N. H. Spinning Mills,	Penacook, N. H.	Sept. 22, 1896.
George P. Grant, Jr.	Treas. Grant Yarn Co.	Fitchburg, Mass.	Sept. 27, 1894.
D. W. Gray	Supt. Skenandoa Cotton Co.	Utica, N. Y.	Oct. 26, 1892.
R. A. Gray	Supt. Rodman Manufg. Co.	Allenton, R. I.	Apr. 24, 1895.
Joseph Warren Greene	Supt.	Wickford, R. I.	Apr. 29, 1896.
William C. Greene	Treas. Peace Dale Manufg. Co.	Peace Dale, R. I.	Oct. 27, 1886.
John T. Greenwood	R. Greenwood & Bault 4720 Leiper St.,	Frankford, Philadelphia, Pa.	Apr. 26, 1900.
S. Greenwood	Mgr. Canadian Col'd Cot. Mills Co. Ltd.	Cornwall, Ontario	Oct. 5, 1899.
John Gregson	Agt. Fiskdale Mills	Fiskdale, Mass.	Apr 24, 1895.
Maxwell Grierson	Gen. Mgr. Jas. Chadwick & Bro., Ltd.,	Jersey City, N. J.	Apr. 27, 1898.
Frederick Grinnell	Pres. Gen. Fire Extinguisher Co.	New Bedford, Mass.	Apr. 24, 1878.
David Grove	Supt. U. S. Cotton Co.	Central Falls, R. I.	Apr. 27, 1898.
Henry S. Grove	Pres. Argo Mills Co., 318 Marine and Merchant Bldg.,	Philadelphia, Pa.	Apr. 27, 1898.
Louis I. Guion	Supt. Columbia Mills Co.,	Columbia, S. C.	Oct. 2, 1902.
Arthur H. Gulliver	Agt. Boston Mfg. Co.	Waltham, Mass.	Apr. 24, 1889.
B. F. Guy	Supt. Pelzer Manufg. Co. Box 125,	Pelzer, S. C.	Apr. 24, 1895.

William J. Hadfield	Newburgh Steam Mills, 236 Montgomery St.,	Newburgh, N. Y.	Apr. 27, 1899.
Frank J. Hale	Gen. Agt. Saco and Pettee Machine Shops	Newton Upper Falls, Mass.	Apr. 27, 1892.
Walter B. Hall	Supt. Pontiac Mill, B. B. & R. Knight,	Pontiac, R. I.	Apr. 25, 1901.
William E. Hall	Treas. Shaw Stocking Co.	Lowell, Mass.	Apr. 27, 1892.
Z. D. Hall	Supt. Berkshire Cotton Mfg. Co. 70 Orchard St., P. O. Box 963,	Adams, Mass.	Oct. 29, 1879.
William Halliwell,	Agt. Providence and Woonsocket Mills of the Lawton Spinning Co.,	Woonsocket, R. I.	Sept. 26, 1901.
John H. Hambly	Treas. Quidnick Manufg. Co. 49 Westminster St.,	Providence, R. I.	Apr. 24, 1895.
Arthur M. Hamilton	Supt. Hargraves and Parker Mills 362 Linden St.,	Fall River, Mass.	Apr. 28, 1897.
John F. Hamlet	Manufacturer P. O. Box 160,	Fall River, Mass.	Oct. 31, 1888.
Joseph O. Hannum	Agt. Indian Head Mills of Alabama	Cordova, Ala.	Apr. 30, 1890.
A. G. Harris,	10 Third St.,	Upper Troy, N. Y.	Sept. 26, 1901.

Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . 340 Main St., Worcester, Mass. . . Apr. 30, 1890.
John J. Hart . . . . . Pres. and Gen. Mgr. Charlton Manufg. Co. . . . . P. O. Box 94, Pawtucket, R. I. . . Apr. 24, 1895.
William D. Hartshorne Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 27, 1899.
Samuel E. Hathaway . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Sept. 27, 1894.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.
William B. Hawes . . Yarn Broker . . . 108 Bedford St., ... P. O. Box 733, Fall River, Mass. Apr. 24, 1895.
Alfred Hawkesworth . Supt. Merchants' Cotton Co. . . . . Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Asst. Supt. Merchants' Cotton Co. . Montreal, P. Q. . . . Sept. 22, 1896.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
W. G. Henderson . . . Agt. Shetucket Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
A. E. Henry, ... Mfr. Partner in Solway Mills, . . . Westerly, R. I. . . . Apr. 25, 1901.
T. I. Hickman, ... Pres. and Treas. Graniteville Mfg. Co. . . . . Leonard Bldg., Augusta, Ga. . . . . Apr. 25, 1901.
Ernest L. Hill . . . . Vice-Pres. Renfrew Mfg. Co. . . . . 320 Broadway, New York City . . . Apr. 24, 1902.
William H. Hill . . . Pres. Windsor Co. and Pres. Renfrew Mfg. Co. . . . . 40 Water St., Boston, Mass. . . . Apr. 24, 1902.
William R. Hill . . . Treas. Glasgow Manufg. Co. . . . . South Hadley Falls, Mass. Oct. 25, 1893.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co. . Fall River. Mass. . Oct. 25, 1895.
Charles H. Hobbs . . Agt. Thorndike Co. . . . . Thorndike, Mass. . . Apr. 28, 1886.
Franklin W. Hobbs . . Treas. Arlington Mills . . . . . P. O. Box 5317, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
William Henry Hobbs . Asst. Supt. Johnson & Johnson Co., New Brunswick, N. J. Apr. 24, 1902.
Louis L. Hohn . . . . Cor. Connecticut Ave. and McDonald St., New London, Conn. Apr. 28, 1897.
Charles M. Holmes . . Supt. Natick Mills . . . . . Natick, R. I., . . . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.
George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
Walter L. Holt . . . . Pres. Holt-Morgan Mills . . . . . Fayetteville, N. C. . . Oct. 18, 1900.
William P. Holt . . . Supt. Barnaby Mills . . . . . Fall River, Mass. . . Oct. 25, 1893.
Edward W. Houghton . Supt. Globe Mill . . . . . Woonsocket, R. I. . . Apr. 24, 1902.
Henry S. Houghton, Jr. Supt. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 24, 1895.
W. C. Houston . . . . Pres. Hope Mills Manufg. Co. . . . . 333 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Elisha H. Howard . . Cotton Goods Broker, 20 Market Sq., Providence, R. I. . . Apr. 25, 1883.
Henry S. Howe . . . . Dry Goods Commission, 89 Franklin St., Boston, Mass. . Oct. 31, 1877.
Albert C. Hoy . . . . . Woonsocket, R. I. . . Apr. 27, 1898.
Charles W. Hubbard . Treas. and Sec. Ludlow Mfg. Associates . . . . . 133 Essex St., Boston, Mass. . . . Apr. 25, 1901.
W. S. Hume . . . . . Supt. Dominion Cotton Mills, Ltd. . . . . 176 Notre Dame St., Hochelaga, P. Q., Can. Oct. 29, 1890.
Otis L. Humphrey, . . Cotton Dept. Lowell Textile School, Lowell, Mass. . . . Apr. 25, 1901.
Arthur W. Hunking . . . . . 374 Stevens St., Lowell, Mass. . . . Apr. 24, 1895.
George A. Hurd, ... 76 Broadway, Dover, N. H. . . . . Apr. 25, 1901.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 28, 1897.

Joseph B. Jamieson . . Mgr. Boston Office of New England Cotton Yarn Co. . . . . 77 Bedford St., Boston, Mass. . . . Oct. 2, 1902.
J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Treas. Samoset Co. . . . . Valley Falls, R. I. . . Sept. 29, 1898.
David L. Jewell . . . Agt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 20, 1865.
David S. Johnston . . Treas. Cohoes Iron Foundry & Mach. Co., Cohoes, N. Y. . Oct. 28, 1891.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 25, 1895.

Frank E. Kaley . . . . Treas. Morse & Kaley Mfg. Co. . . Milford, N. H. . . . Oct. 25, 1895.
W. E. Keach . . . . . Supt. Grant Yarn Co. . 123 Myrtle Ave., Fitchburg, Mass. Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
George E. Kent . . . . Treas. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Oct. 31, 1888.
Hervey Kent . . . . . Pres. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Apr. 20, 1865.
Nathaniel B. Kerr . . . Treas. Butler Mill . . . . . New Bedford, Mass. . Oct. 26, 1892.
John Kilburn . . . . . Belmont, Mass. . . . Apr. 20, 1865.
Harry W. Kimball . . Supt. Fulton Bag & Cotton Mills . Atlanta, Ga. . . . . Oct. 25, 1895.
William N. Kimball . . Supt. Social and Nourse Mills, Manville Co. . . . . Woonsocket, R. I. . . Apr. 24, 1902.
Emil Kipper . . . . . Treas. Renfrew Mfg. Co. and Windsor Print Works . . . . . Adams, Mass. . . . . Apr. 24, 1902.
Albert F. Knight . . . . . Box 133, 39 Main St., Woonsocket, R. I. . . Oct. 27, 1886.
Jesse A. Knight . . . . Supt. Cohannet Mills . . . . . Taunton, Mass. . . . Oct. 26, 1892.
Stephen A. Knight . . Pres. Hebron Manufg. Co., Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . Reynolds Manufg. Co. . . . . Davisville, R. I. . . Apr. 24, 1889.
Webster Knight . . . B. B. & R. Knight's Mills . . . . . 3 Washington Row, Providence, R. I. . . Oct. 31, 1888.

Fred Lacey . . . . . Mgr. Montreal Cotton Co. . . . . Valleyfield, P. Q. . . Apr. 24, 1895.
Elliott Cowdin Lambert Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 25, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw . Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.
George H. Law . . . Supt. Merchants' Mfg. Co. . . . . 815 Walnut St., Fall River, Mass. . . Apr. 28, 1897.
Harold Lawton . . . . Mgr. Baltic Mills Co. . . . . Baltic, Conn. . . . . Oct. 27, 1886.
John Edward Lawton . Governing Director American Thread Co., ... Matlock, Derbyshire, England . Apr. 25, 1901.
Calvin H. Lee . . . . Supt. Readville Cotton Mills . . . Hyde Park, Mass. . . Apr. 24, 1902.
Evan Arthur Leigh . . Textile Machinery . . 70 Kilby St., Boston, Mass. . . . Oct. 29, 1890.
John Leiper . . . . . Supt. Fitchburg Worsted Mills, Upland Road . . . . . Fitchburg, Mass. . . Oct. 28, 1897.
J. Colby Lewis . . . . Supt. & Mgr. Vesta Cotton Mills, . . Gainesville, Ga. . . . Oct. 26, 1892.
Charles F. Libby . . . Supt. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 24, 1902.
Leontine Lincoln . . . Pres. Seaconnet Mills . . . . . Fall River, Mass. . . Apr. 28, 1897.

B. F. G. Linnell	Commission Merchant, Yarns, Threads and Twines	P. O. Box 645, Central Falls, R. I.	Oct. 28, 1897.
Charles Warren Lippitt,	Treas. Silver Spring B. & D. Co.	7 Young Orchard Ave., Providence, R. I.	Oct. 30, 1878.
Henry F. Lippitt	Agt. Social and Manville Cos.	Providence, R. I.	Apr. 27, 1881.
William H. Loftus	Supt. Clark Thread Co.	Newark, N. J.	Oct. 28, 1897.
Robert W. Lord	Agt. R. W. Lord & Co.	Kennebunk, Me.	Oct. 20, 1869.
Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Agt. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William C. Lovering	Pres. Whittenton Manufg. Co.,	40 Water St., Boston, Mass.	Oct. 25, 1876.
William M. Lovering	Supt. Whittenton Manufg. Co.	Taunton, Mass.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Manufg. Co.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Asst. Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
A. Lawrence Lowell	Trustee	53 State St., Boston, Mass.	Apr. 25, 1901.
Dudley T. Lyall	Sec. Brighton Mills	Passaic, N. J.	Sept. 22, 1896.
William L. Lyall	Treas. Brighton Mills	Passaic, N. J.	Oct. 26, 1892.
Herbert Lyman		505 Sears Bldg., Box 1717, Boston, Mass.	Oct. 25, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
Alvin S. Lyon	Supt. Bigelow Co.	Lowell, Mass.	Apr. 26, 1882.
James R. MacColl	Treas. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Charles L. Macomber	Pres. Winthrop Cotton Yarn Co.	Taunton, Mass.	Apr. 24, 1895.
Frederick B. Macy,	Treas. Soule Mills,	New Bedford, Mass.	Apr. 25, 1901.
Amos G. Maddox	Supt. Linwood Mill	Linwood, Mass.	Oct. 18, 1900.
Charles T. Main	Mech. and Mill Engineer, Dean & Main	53 State St., 1112 Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
A. T. Malcolmson	Agt. C. Bischoff & Co.	19 George St., Box 1104, Providence, R. I.	Oct. 28, 1897.
Arthur B. Mann	J. H. Martin & Co.,	Box 465, 99 Franklin St., New York, N. Y.	Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 28, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 182, Griffin, Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin	Supt. Danielson Cotton Mfg. Co.,	Danielson, Conn.	Apr. 28, 1897.
Arthur H. Mason	Treas. Barnaby Mfg. Co.	Fall River, Mass.	Oct. 2, 1902.
John R. Mason		523 Broadway, Fall River, Mass.	Apr. 28, 1897.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Scott Maxwell,	Supt. Lanett Cotton Mills	West Point, Ga.	Sept. 26, 1901.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAuliffe	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 27, 1898.

Albert E. McDonald	Agt. Lawrenceville Mfg. Co.,	Lawrenceville, Ga.	Oct. 2, 1902.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2934, 40 Water St., Boston, Mass.	Oct. 25, 1882.
James A. McLane	Supt. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
William G. McLoon	Supt. Lancaster Mills,	Clinton, Mass.	Apr. 27, 1892.
Robert G. McMeehan,	Supt Uncasville Mfg. Co.	Uncasville, Conn.	Sept. 26, 1901.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Agt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Henry P. Meikleham,	Agt. Mass. Mills in Georgia	Lindale, Floyd Co., Ga.	Apr. 26, 1900.
Joseph Mercer	Agt. and Treas. Willimantic Cotton Mills Co.	Willimantic, Conn.	Apr. 24, 1902.
Charles H. Merriman, Jr.	Social Mfg. Co.	Providence, R. I.	Apr. 24, 1895.
Joseph Merriam	Pres. Springfield Webbing Co.	Middletown, Conn.	Oct. 2, 1902.
W. H. Miles	Agt. Farwell Mills	Lisbon, Me.	Sept. 22, 1896.
R. M. Miller, Jr.	Pres. & Treas. Elizabeth Mills	Charlotte, N. C.	Sept. 29, 1898.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	Supt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 29, 1896.
David Milne	C. J. Milne & Sons Washington Ave. & 11th St.,	Philadelphia, Pa.	Apr. 28, 1897.
A. B. Mole	Gen. Mgr. Dominion Cotton Mills Co.,	Montreal, P. Q.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Lonsdale Mills	Lonsdale, R. I.	Apr. 24, 1895.
J. R. Montgomery	Pres. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 29, 1898.
George A. Moody	Supt. West Warren Cotton Mills	West Warren, Mass.	Apr. 27, 1899.
Fred W. Moore	Agt. Cordis Mills	P. O. Box 582, Millbury, Mass.	Apr. 27, 1892.
James Sumter Moore	Sec. and Treas. Olympia & Richland Cotton Mills	Columbia, S. C.	Apr. 26, 1900.
George B. Morison	Pres. Ballou Yarn Co.,	78 Chauncy St. Boston, Mass.	Apr. 24, 1902.
Albert H. Morton	Supt. Kitson Machine Co.	Lowell, Mass.	Oct. 28, 1891.
E. P. Morton,	Agt. Stevens Linen Works	Webster, Mass.	Sept. 26, 1901.
Oliver H. Moulton	Supt. Hamilton Manufg. Co.	Lowell, Mass.	Apr. 20, 1865.
Farquharson J. Muir	Mgr. Fort Mill Mfg. Co. and Millfort Mill Co.,	Fort Mill, S. C.,	Apr. 27, 1892.
John Neild	Supt. Grinnell Mfg. Co.	New Bedford, Mass.	Apr. 25, 1901.
Roscius C. Newell	Supt. Palmer Mill	Three Rivers, Mass.	Oct. 25, 1895.
William G. Nichols	Sec. and Treas. Springstein Mills	Chester, S. C.	Oct. 25, 1893.
William M. Nixon	Pres. Atlanta Woolen Mills	Atlanta, Ga.	Oct. 5, 1899.
Albert W. Noone,	Prop. & Mgr. Jos. Noone's Son's Co.	Peterboro, N. H.	Sept. 26, 1901.
Franklin Nourse	Agt. Lawrence Manufg. Co.	Lowell, Mass.	Apr. 24, 1878.
S. Odenheimer	Treas. Lane Mills	New Orleans, La.	Oct. 25, 1893.
Charles K. Oliver	Treas. Continental Bldg.,	Baltimore, Md.	Sept. 27, 1894.
J. Edward Osborn	Treas. American Linen Co.	Fall River, Mass.	Apr. 28, 1897.
Henry Osgood,	6 Munroe St., P. O. Box 204,	Salem, Mass.	Apr. 25, 1901.
Herbert W. Owen	Supt. Cocheco Mfg. Co.	Dover, N. H.	Oct. 5, 1899.
Oscar L. Owen	Mech. and Mill Eng. Whitin Machine Works	Whitinsville, Mass.	Apr. 25, 1894.

Elmer E. Page	Agt. York Manufg. Co.	Saco, Me.	Apr. 27, 1892.
O. B. Parker	Supt. Laurens Cotton Mills	Laurens, S. C.	Apr. 24, 1895.
Samuel L. Parker	Supt. Turners Falls Cotton Mills	Box 627, Turners Falls, Mass.	Apr. 29, 1896.
Walter E. Parker	Agt. Pacific Mills, 217 Haverhill St.,	Lawrence, Mass.	Apr. 25, 1877.
John H. Parks	John H. Parks & Co., 93 Germain St.,	St. John, N. B.	Apr. 24, 1878.
Duncan D. Parmly	Treas. Johnson Mfg. Co. and Dunbar Mills Co.	160 Broadway, New York, N. Y.	Sept. 22, 1896.
Samuel F. Patterson	Pres. and Treas. Thistle Mills Co.	Ilchester, Md.	Oct. 18, 1900.
John W. Pead	Agt. Merrimack Manufg. Co.	Box 1231, Lowell, Mass.	Apr. 26, 1893.
James R. Pearce	Supt. Monaghan Mills	Greenville, S. C.	Oct. 25, 1895.
William C. Peirce	Pres. Elizabeth Mills . 564 Eddy St.,	Providence, R. I.	Apr. 24, 1895.
William D. Pennell	Agt. Hill Manufg. Co.	Lewiston, Me.	Apr. 16, 1873.
Haven C. Perham	Treas. Kitson Machine Co.	Lowell, Mass.	Apr. 30, 1879.
Henry C. Phillips	Supt. Greylock Mills,	North Adams, Mass.	Apr. 25, 1894.
Benjamin Phipps	Merchant	4 Winthrop Sq. Boston, Mass.	Sept. 29, 1898.
Albert R. Pierce	Supt. Pierce Mfg. Corp.	New Bedford, Mass.	Oct. 5, 1899.
Andrew G. Pierce, Jr.	Treas. Pierce Manufg. Corp.	P. O. Box, 34, New Bedford, Mass.	Apr. 24, 1895.
Reuben Pilling, Jr.		30 Hudson St., Providence, R. I.	Apr. 29, 1896.
Charles H. Plummer	Agt. Great Falls Manufg. Co.	Somersworth, N. H.	Apr. 25, 1888.
Charles T. Plunkett	Sec. Berkshire Cotton Mfg. Co.	Adams, Mass.	Apr. 28, 1897.
Charles H. Potter,	Supt. Montreal Cotton Co.,	Valleyfield, P. Q.,	Apr. 25, 1901.
Joseph H. Potter, Jr.	Supt. Durfee Mills	Fall River, Mass.	Apr. 27, 1899.
J. F. Powers	Supt. Spinning Mill	Middletown, Conn.	Oct. 5, 1899.
Herbert L. Pratt	Agt. Bates Manufg. Co.	Lewiston, Me.	Oct. 27, 1875.
T. W. Pratt	Pres. West Huntsville Cotton Mill Co.	Huntsville, Ala.	Sept. 22, 1896.
George E. Prest	Supt. No. 1 Harmony Mill	Cohoes, N. Y.	Apr. 24, 1902.
Harry B. Prest	Asst. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 24, 1902.
John E. Prest	Gen. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 17, 1872.
M. W. Quinn	Agt. Hamilton Woolen Co.	Amesbury, Mass.	Oct. 27, 1886.
John W. Ramsbottom	Supt. Samoset Co.	Valley Falls, R. I.	Apr. 24, 1902.
T. G. Ramsdell	Agt. Monument Mills	Housatonic, Mass.	Oct. 30, 1878.
Emory S. Rathbun	Supt. Pequot Mills	Montville, Conn.	Apr. 27, 1899.
M. A. Rawlinson	Supt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 24, 1895.
John F. Reardon	Agt. Falls Co.	Norwich, Conn.	Apr. 26, 1900.
Robert Redford	Mfr.	Box 28, Lawrence, Mass.	Apr. 26, 1882.
R. S. Reinhardt	Treas. and Mgr. Elm Grove Cotton Mills,	Lincolnton, N. C.	Apr. 27, 1898.
L. B. Renfrew	Treas. Renfrew Mfg. Co.	Adams, Mass.	Oct. 5, 1899.
T. H. Rennie	Supt. Graniteville Mfg. Co.	Graniteville, S. C.	Oct. 18, 1900.
Frederick W. Reynolds,	Supt. Potomska Mills,	Box 299, 20 Fifth St., New Bedford, Mass.	Apr. 26, 1900.

Francis H. Rice . . . . Pres. Holbrook Mfg. Co. . . . . Millbury, Mass. . . . Apr. 28, 1880.
John Bion Richards . . Treas. Davis Mill . . . . . Fall River, Mass. . . Apr. 24, 1902.
Charles H. Richardson Agt. Lancaster Mills . . . . . Clinton, Mass. . . . Apr. 24, 1889.
W. H. Richmond . . . Supt. Bibb Mill No. 2 . . . . . Macon, Ga. . . . . Oct. 28, 1897.
Walter Rigby . . . . Cotton Mfr., Care Stoddard, Haserick, Richards & Co. . .
. . . . . 152 Congress St., Boston, Mass. . . . Apr. 26, 1900.
Charles E. Riley . . . Textile Machinery, C. E. Riley & Co. . . . . .
. . . . . 281 Congress St., Box 2815, Boston, Mass. . . . Apr. 25, 1888.
William H. Ritter . . . Gen. Supt. and Purchasing Agt. Johnson & Johnson . . .
. . . . . 266 George St., New Brunswick, N. J. Apr. 26, 1900.
George W. Robbins . . Supt. Dyerville Mfg. Co., ...
. . . . . 610 Manton Ave., Providence, R. I. . . Apr. 28, 1897.
Benj. H. Roberts . . . General Mill Supplies 163 Grove St., Fall River, Mass. . . Apr. 26, 1900.
Charles D. Robinson . Supt. Crompton Co. . . . . Crompton, R. I. . . . Sept. 27, 1894.
Edwin A. Robinson . . Asst. Supt. Tremont and Suffolk Mills Lowell, Mass. . . . . Oct. 18, 1900.
William A. Robinson . Manville Co. . . . . Woonsocket, R. I. . Apr. 29, 1896.
William H. Robinson . Supt. No. 3 Harmony Mill . . . . Cohoes, N. Y. . . . Apr. 24, 1902.
W. H. Rose . . . . . Sec'y & Treas. Granby Cotton Mills, Columbia, S. C. . . . Oct. 18, 1900.
John R. Rostron . . . Lancaster Mills . . . . . Clinton, Mass. . . . Sept. 29, 1898.
John K. Russell . . . . . 476 Hall St., Manchester, N. H. . Apr. 29, 1891.

Alfred Sagar . . . . . Supt. Arlington Cotton Mills . . . . . .
. . . . . 15 High St., Methuen, Mass. . . Apr. 24, 1902.
Edward H. Sanborn . . Vice Pres. Cold Spring Bleaching and Finishing Works . .
. . . . . North American Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Richard W. B. Sanderson G. S. Lings & Co., Yarn Merchants . . . . . .
. . . . . P. O. Box 1323, Providence, R. I. . . Apr. 24, 1902.
Arnold B. Sanford . . Pres. American Cotton Yarn Exchange . . . . . .
. . . . . 67 Chauncy St., Boston, Mass. . . . Oct. 25, 1882.
Pardon B. Sanford . . Supt. Utica Spinning Co. . . . . Utica, N. Y. . . . . Oct. 2, 1902.
J. Herbert Sawyer . . . . . 93 Federal St., Boston, Mass. . . . July 19, 1865.
F. C. Sayles . . . . . Pres. Baltic Mills Co. . . . . .
. . . . . 204 Banigan Bldg., Providence, R. I. . . Oct. 28, 1897.
George H. Sayward . . . . . Winchester, Mass. . Oct. 29, 1890.
Arnold Schaer . . . . Agt. Warren Manufg. Co. . . . . Warren, R. I. . . . Apr. 24, 1895.
Theodore C. Search . . Pres. Cold Spring Bleaching and Finishing Works . . . .
. . . . . North American Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Albion K. Searls . . . Supt. Ogden Mill (Harmony Mills) . Cohoes, N. Y. . . . Apr. 24, 1902.
Charles M. Sears . . . Supt. West Point Mfg. Co. . . . . Langdale, Ala. . . . Apr. 27, 1898.
George H. Shapley . . Treas. Silver Lake Co., 78 Chauncy St. . . . . .
. . . . . Boston, Mass. . . . . Apr. 29, 1896.
Frank P. Sheldon . . . Mill Engineer and Architect . . . . . .
. . . . . Industrial Trust Bldg. Providence, R. I. . . Apr. 25, 1894.
Thomas C. Sheldon . . Agt. Fitchburg Duck Mills . . . . . .
. . . . . 8 School St., Fitchburg, Mass. . . Oct. 29, 1884.
Willis S. Shepard . . . Pres. American Net and Twine Co. . Canton, Mass. . . . Apr. 29, 1896.

William F. Sherman	Mill Engineer	107 New Brazer Bldg., 27 State St., Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
Herbert H. Shumway	Treas. and Agt. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
Nathaniel G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 27, 1898.
Louis Simpson		Victoria Chambers, Ottawa, Ont.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills	863 High St., Fall River, Mass.	Oct. 25, 1893.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 25, 1895.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 27, 1898.
Joel Smith	Supt. The J. P. King Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 28, 1897.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 30, 1884.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 27, 1898.
George E. Spofford	Supt. Blackstone Mfg. Co.	Blackstone, Mass.	Apr. 29, 1896.
Henry B. Sprague	Treas. Boston Woven Hose and Rubber Co.	Lynn, Mass.	Oct. 5, 1899.
Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 25, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
T. B. Stevenson	Supt. Readville Cotton Mill	Hyde Park, Mass.	Apr. 26, 1900.
Robert Stewart	Asst. Supt. Lonsdale Co.	Ashton, R. I.	Apr. 27, 1899.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 25, 1895.
O. W. Stites	Elliott Fuel Saving Co.	Durham, N. C.	Oct. 25, 1895.
B. L. Stowe	Vice-Pres. Eureka Fire Hose Co.	Wilkinson and Arlington Aves., Jersey City, N. J.	Sept. 26, 1901.
Herman F. Straw	Agt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
John Sullivan	Supt. Union Cotton Mfg. Co.	Fall River, Mass.	Apr. 27, 1899.
Timothy Sullivan	Supt. Davol Mills	Fall River, Mass.	Apr. 27, 1899.
Walter H. Summersby	Agt. Atlantic Cotton Mills	Lawrence, Mass.	Oct. 25, 1893.
D. G. Sunderland	Treas. The Pelham Mills	Pelham, S. C.	Oct. 18, 1900.
James O. Sweet	Agt. and Treas. Ashland Cotton Co.	Jewett City, Conn.	Apr. 28, 1886.
Robert Rennie Taft		P. O. Box 1443, Providence, R. I.	Apr. 24, 1895.
Robert W. Taft	Treas. Coventry Co.	Box 1144, Providence, R. I.	Sept. 27, 1894.
George P. Taylor	Treas. Danielsonville Cotton Co. of	Danielson, Conn.	
		Clinton, Mass.	Oct. 27, 1880.
James W. Taylor	Agt. Canoe River Mills	Box 46, Taunton, Mass.	Oct. 26, 1892.
W. Marshall Taylor	Gen. Mgr. National Flax Fibre Co.	Box 327, Millis, Mass.	Sept. 22, 1896.
Richard Thackeray	Supt. Weetamoe Mills	Fall River, Mass.	Apr. 29, 1885.
S. Willard Thayer	Treas. Dexter Yarn Co.	Pawtucket, R. I.	Sept. 26, 1901.
Earl A. Thissell		47 Mt. Vernon St., Lowell, Mass.	Oct. 30, 1878.

Ariel C. Thomas . . . Agt. Boott Cotton Mills . . . . . 62 Mt. Vernon St., Lowell, Mass. . . . Oct. 31, 1888.
Charles E. Thomas . . Treas. Forestdale Manufg. Co. . . . . 44 Prospect St., Woonsocket, R. I. . . Oct. 31, 1883.
Edward W. Thomas . . Gen. Mgr. Erwin, Pearl, Durham, ... Alpine and Cooleemee Cotton Mills, Cooleemee, N. C. . . Apr. 30, 1884.
D. M. Thompson . . . Gen. Mgr. B. B. and R. Knight's Mills . . . . . Box 1442, Providence, R. I. . . Oct. 28, 1885.
James O. Thompson, Jr. Supt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 18, 1900.
Ralph E. Thomson . . Supt. Parkhill Manufg. Co., Mill C. Fitchburg, Mass. . . Apr. 25, 1894.
Joseph S. Tidd . . . . Treas. Oakland Mills . . . . . Taunton, Mass. . . . Apr. 27, 1899.
Horace W. Tinkham . Treas. and Agt. Robeson Mills . . . Fall River, Mass. . . Apr. 27, 1899.
R. Irving Tobey . . . Mgr. Cold Spring Bleaching and Finishing Works . . . . . Yardley, Pa. . . . . Oct. 2, 1902.
W. O. Todd . . . . . Sec. and Treas. Lawton Spinning Co. Box 1125, ... 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.
James P. Tolman . . . Pres. Samson Cordage Works . . . . . 115 Congress St., Boston, Mass. . . . Oct. 29, 1890.
Daniel A. Tompkins . Pres. Atherton Mills . . . . . Charlotte, N. C. . . . Oct. 25, 1895.
M. J. Toohey . . . . Mfr. Rope, Twine and Banding . . Fall River, Mass . . Oct. 2, 1902.
George W. Towne . . . Mgr. Columbus Power Co. . . . . Columbus, Ga. . . . Oct. 26, 1892.
Edward B. Townsend, . Treas. Warwick Mills, ... 27 Kilby St., Boston, Mass. . . . Apr. 25, 1901.
Robert B. Treat . . . . Prop. Centreville Cotton Mills . . . Centreville, R. I. . . Sept. 27, 1894.
C. H. Truesdell . . . . Supt. Attawaugan Co. . . . . Killingly, Conn. . . Oct. 29, 1884.
Edmund E. Truesdell . Supt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 26, 1876.
Oscar B. Truesdell . . . . . 18 Washington Terrace, Newtonville, Mass. . Oct. 15, 1873.
George E. Tucker . . . Agt. Otis Co. . . . . Ware, Mass. . . . . Oct. 25, 1895.
Philip S. Tuley . . . Pres. and Treas. Louisville Cotton Mills Co. . . . . 1008 Goss Ave., Louisville, Ky. . . . Oct. 18, 1900.
George W. Turner . . Supt. Argo Mills Co. . . . . Gloucester, N. J. . . Apr. 26, 1900.
William D. Twiss . . . Supt. Everett Mills . . . . . Lawrence, Mass. . . . April 29, 1896.

Charles T. Upton . . . . . 63 Mt. Vernon St., Lowell, Mass. . . . Apr. 28, 1897.

George A. Vaughan . . Supt. The Putnam Manufg. Co. . . Putnam, Conn. . . . Sept. 22, 1896.
William P. Vaughan . Agt. Putnam Manufacturing Co. . . . . 1041 Banigan Building, Providence, R. I. . . Sept. 29, 1898.
Eugene F. Verdery . . Pres. and Treas. Warren Mfg. Co. . . . . 739 Reynolds St., Augusta, Ga. . . . . Apr. 26, 1900.
James P. Verdery . . . Pres. Enterprise Mfg. Co. . . . . Augusta, Ga. . . . . Apr. 26, 1900.
Frank P. Vogl . . . . Agt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 27, 1894.

Jude C. Wadleigh . . . Supt. Mass. Cotton Mills . . . . . Lowell, Mass. . . . Oct. 26, 1892.
Herbert E. Walmsley . Agt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 29, 1890.
Robinson Walmsley . . Supt. Tecumseh Mills, P. O. Box 246, Fall River, Mass. . . Apr. 27, 1899.
Frederick T. Walsh . . Mgr. Thomas Leyland & Co., Dyestuffs, etc. . . . . 53 India St., Boston, Mass. . . . Apr. 28, 1897.

James A. Walsh . . . Agt. Lewiston Bleachery and Dye Works . . . . . Lewiston, Me. . . . Apr. 27, 1892.
Joseph Watters . . . . Supt. Osborn Mills . . . . . Fall River, Mass. . . Oct. 15, 1873.
F. E. Wattles . . . . Agt. Boscawen Mills . . . . . Penacook, N. H. . . Oct. 5, 1899.
George W. Weeks . . . . . 330 Church St., Clinton, Mass. . . . Apr. 20, 1870.
W. B. Smith Whaley . Mechanical & Mill Engineer, Pres. Richland Cotton Mills, ... Granby Cotton Mills, 1013 Tremont Bldg., Boston, Mass, ... 1328 Main St., Columbia, S. C. . . Apr. 24, 1895.
H. D. Wheat . . . . . Pres. and Treas. Gaffney Mfg. Co. and Pres. and Treas. . . . . Orient Mfg. Co., Charlotte, N. C., Gaffney, S. C. . . . Apr. 24, 1895.
Channing Whitaker . . Infringement and Patentability of Inventions . . . . . Lowell Machine Shop . . . . . Lowell, Mass. . . . Oct. 15, 1873.
A. Tenny White . . . Supt. Manville Co. . . . . Manville, R. I. . . . Oct. 27, 1887.
Alphonso F. White . . Supt. Forestdale Mfg. Co., ... Forestdale, R. I. . . Apr. 24, 1902.
Charles D. White . . . Agt. Uncasville Mfg. Co. . . . . Norwich, Conn. . . . Oct. 28, 1897.
Arthur F. Whitin . . . Pres. and Treas. Saunders Cotton Mills . . . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred B. Whitin . . . . Agt. and Treas. Uxbridge Cotton Mills, Linwood, Mass. . . Apr. 28, 1897.
Henry T. Whitin . . . Treas. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 25, 1877.
Alfred N. Whiting . . Sec. and Treas. L. M. Harris Manufg. Co. . . . . 167 Pleasant St., Worcester, Mass. . . Apr. 21, 1875.
William Whitman . . Pres. Arlington Mills, ... P. O. Box 3590, ... 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
William S. Whitney . . Supervising Engineer, American Woolen Co. . . . . Lawrence, Mass. . . Apr. 24, 1878.
Arthur Whittam . . . Director Miss. Textile School and Pres. John M. Stone Cotton Mills . . . . . Starkville, Miss., . . Apr. 27, 1898.
William Whittam, Jr. . Vice Pres. & Gen. Mgr. The William Whittam Textile Co. . . . . Ashville, N. C. . . . Apr. 26, 1893.
George F. Whitten . . Agt. Amory Mfg. Co. . . . . Manchester, N. H. . Oct. 26, 1892.
John H. Whitten . . . Agt. Stark Mills . . . . . Manchester, N. H. . Apr. 27, 1898.
Nelson Whittier . . . Treas. Whittier Mills . . . . . Springfield, Mass. . . Oct. 18, 1900.
W. R. B. Whittier . . Mgr. Whittier Mills . . . Chattahoochee, Fulton Co., Ga. . Oct. 18, 1900.
George A. Wies . . . . Treas. Eureka Fire Hose Co. . . . . 13 Barclay St., New York City . . . Apr. 24, 1902.
Edward B. Wilbur . . Gen. Mgr. Mollohon Mfg. Co. . . . Newbury, S. C. . . . Oct. 30, 1889.
Benjamin Wilcox . . . Treas. City and Bristol Mfg. Co. . . New Bedford, Mass. . Apr. 26, 1900.
Henry M. Wilcox . . . Treas. John Rhodes Warp Co. . . . Millbury, Mass. . . . Apr. 24, 1889.
John B. Wild . . . . Pres. Oneita Knitting Mills . . . . Utica, N. Y. . . . . Apr. 26, 1900.
Eben C. Willey . . . . Treas. Holbrook Mfg. Co. , ... Millbury, Mass. . . Apr. 29, 1896.
Franklin D. Williams . Treas. Fiskdale Mills, ... 87 Milk St., Room 21, Boston, Mass. . . . . Apr. 25, 1901.
Broadus E. Willingham, Sec. and Treas. Willingham Cotton Mills . . . . . Macon, Ga. . . . . Oct. 18, 1900.
Theop. W. Wilmarth . . . . . 1205 Floyd St., Lynchburg, Va. . . . Oct. 31, 1883.
William E. Winchester . Teacher of Cotton Carding and Spinning, Philadelphia . . . . . Textile School, Broad and Pine Sts., Philadelphia, Pa. . . Apr. 24, 1902.

George Wood . . . . Pres. and Treas. Millville Manufg. Co. . . . . 626 Chestnut St., Phila., Pa. . . . . Oct. 16, 1872.
John P. Wood . . . . . Spring Garden and 22d Sts., Philadelphia, Pa. . . Apr. 28, 1897.
Oscar W. Wood . . . Treas. Germantown Spinning Co. . . . . Germantown, Philadelphia, Pa. . . Oct. 18, 1900.
C. J. H. Woodbury . . Secretary and Treasurer . . . . . Lynn, Mass. . . . . Oct. 29, 1879.

Adelbert R. Young . . Supt. Ashland Cotton Co. . . . . Jewett City, Conn. . . Apr. 25, 1894.
James M. Young . . . Mgr. Hamilton Cotton Co. . . . . Hamilton, Ont., Can. Apr. 27, 1899.

ASSOCIATE MEMBERS.

S. B. Alexander, Jr. . . Pres. S. B. Alexander, Jr. Co. . . . Charlotte, N. C. . . . Oct. 18, 1900.
Eugene C. Andres . . Exporter and Importer . . . . . 577 John Hancock Building, Boston, Mass. . . . . Oct. 18, 1900.
Henry B. Ashton . . . Agt. S. A. Felton & Son Co. . . . . 153 Adams St., Medford, Mass. . . . Apr. 26, 1900.
Henry Ashworth . . . Agt. of Elijah Ashworth, Mfr. of Card Clothing . . . . . 89 Globe Mills Ave., Box 427, Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Pres. and Gen. Mgr. American Oil Co. . . . . 182 So. Water St., Providence, R. I. . . Apr. 24, 1895.
D. C. Ball . . . . . 27 William St., New York, N. Y. . . Oct. 25, 1895.
Edwin Barnes . . . . Vice Pres. Wm. Firth Co. . . . . 67 Equitable Building, Boston, Mass. . . . . Apr. 26, 1900.
George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.
Colin C. Bell . . . . Vice-Pres. American Vulcanized Fibre Co., Laminar Dept., ... 1017 Market St., Wilmington, Del. . . Apr. 29, 1896.
Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.
William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.
Albert Birch . . . . . Somerville Machine Works, Kent St., Somerville, Mass. . Oct. 2, 1902.
F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 95 South St., Boston, Mass. . . . . Apr. 26, 1900.
Edmund E. Blake . . Selling Agt. Saco & Pettee Machine Shops . . . . . Newton Upper Falls, Mass. Oct. 2, 1902.
Arthur T. Bradlee, . . Mgr. Cotton Yarn Dept., Harding, Whitman & Co. . . . . 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
J. Payson Bradley . . . The Kehew Bradley Co. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
J. Frank Braids . . Mgr. Grease & Oil Dept., Charles S. Bush Co. . . . . 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.
Henry Gordon Brinckerhoff, N. E. Mgr. Green Fuel Economizer Co., Box 2654 . . . . . Room 1053, Exchange Bldg., 53 State St., Boston, Mass. Sept. 22, 1896.

D. Russell Brown . . . Pres. Brown Bros. Co. . . . . 62 Exchange Place, Providence, R. I. . . . Apr. 24, 1895.
H. Martin Brown . . . Treas. U. S. Bobbin & Shuttle Co. . Providence, R. I. . . . Apr. 24, 1895.
Percy H. Brundage . . . . . 49 Wall St., New York, N. Y. . . . Oct. 5, 1899.
John H. Burghardt . . Page Belting Co. . . . . 31 Pearl St., Boston, Mass. . . . . Apr. 24, 1895.
Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . . Oct. 25, 1895.
Fred N. Bushnell . . . Mech. Supt. Narragansett Electric Light Co. . . . . 3 South St., Providence, R. I. . . . Sept. 29, 1898.
Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . . Oct. 28, 1897.
James Butterworth . Pres. H. W. Butterworth & Sons Co. . . . . York and Cedar Sts., Philadelphia, Pa. . . . Apr. 24, 1895.

Albert L. Calder, 2nd . Cotton Dealer . . . . . 28 Market Square, Box 206, Providence, R. I. . . . Apr. 26, 1900.
French Campbell . . . Commission Merchant, 75 Granite St., Manchester, N. H. . Oct. 28, 1897.
Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . . Apr. 24, 1895.
W. W. Carey . . . . . Mfr. Wood Rim Pulleys and Wood Working Machinery . . . . . 514 Broadway, Lowell, Mass. . . . . Apr. 24, 1895.
Albert C. Case . . . . Pres. American Cotton Co. . . . . 25 Broad St., New York, N. Y. . . . Sept. 26, 1901.
J. E. Cheesman . . . . Gen. Mgr. Cheesman Cotton Gin Co. . . . . 27 William St., New York, N. Y. . . . Oct. 5, 1899.
Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . P. O. Box 1426, 77 Exchange Place, Providence, R. I. . . . Apr. 24, 1895.
Henry C. Clark . . . . Pres. Charlotte Supply Co. . . . . Charlotte, N. C. . . . Apr. 27, 1898.
Melvin H. Coffin . . . Selling Agt. Whitin Machine Works Whitinsville, Mass. . Oct. 2, 1902.
C. C. Cowan . . . . . 27 William St., New York, N. Y. . . . Oct. 5, 1899.
Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . Box 316, Taunton, Mass. . . . Apr. 24, 1895.
George Crompton . . . . . Worcester, Mass. . . . Oct. 28, 1897.
C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.
Joseph L. Cushing . . Mfr. of Cotton Conveying Systems, Daniel Cushing & Co., ... Box 885, Lowell, Mass. . . . . Apr. 26, 1900.

Frederick I. Dana . . . Sec. and Mgr. Thomas Phillips Co. Providence, R. I. . . . Apr. 24, 1895.
E. W. Davenport . . . Mgr. Crompton & Knowles Loom Works . . . . . Providence, R. I. . . . Sept. 26, 1901.
John O. DeWolf, . . . Mech. Engineer, 1012 Tremont Bldg., Boston, Mass. . . . Apr. 25, 1901.
C. E. W. Dow . . . . So. Agt. American Moistening Co. & Wm. Firth Co. . . . . Room 813, Empire Bldg., Box 410, Atlanta, Ga. . . . . Apr. 24. 1895.
Frederick A. Downes . Sec. Factory Mutual Fire Insurance Cos. . . . . 925 Chestnut St., Philadelphia, Pa. . . . Oct. 28, 1897.
W. L. Draper . . . . Mgr. Dodge Mfg. Co. . . . . Atlanta Branch, 522 Prudential Building, Atlanta, Ga. . . . . Oct. 18, 1900.

Fred W. Easton, . . . Treas. Easton & Burnham Machine Co., ... 180 Weeden St., Pawtucket, R. I. . . . Apr. 25, 1901.

William Dresser Edwards New Eng. Rep. Buffalo Forge Co. . . . . Board of Trade Bldg., Boston, Mass. . . . Oct. 2, 1902.

G. B. Emmons . . . . Pres. Emmons Loom Harness Co. . . . . May St., Lawrence, Mass. . . . Oct. 25, 1895.

T. C. Entwistle . . . . Treas. T. C. Entwistle Co. . . . . 297 Market St., Lowell, Mass. . . . . Apr. 24, 1895.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.

John W. Ferguson . . Contractor . . . . . Paterson Nat. Bank Bldg., Paterson, N. J. . . . Apr. 24, 1895.

Joseph Fossel . . . . Cotton Machinery Expert . . . . . 152 Congress St., Boston, Mass. . . . Oct. 2, 1902.

J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . . Apr. 24, 1895.

Merrill A. Furbush . . . . . 2015 North 33rd St., Philadelphia, Pa. . . . Oct. 28, 1897.

John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . . Apr. 28, 1897.

H. P. Garland . . . . Treas. Loom Picker Co. . . . . Biddeford, Me. . . . Oct. 25, 1895.

Royal W. Gates . . . . Josiah Gates & Sons, Belting . . . . . 75 Gates St., Lowell, Mass. . . . Apr. 24, 1895.

Rufus B. Goff . . . . Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . . Apr. 28, 1897.

Sumner S. Gould . . . Mgr. Lowell Branch American Card Clothing Co. . . . . 112 Fremont St., Lowell, Mass. . . . Oct. 5, 1899.

William S. Granger . . Prest. Granger Foundry & Machine Co., Providence, R. I. . Apr. 24, 1895.

Henry T. Grant, Jr. . . . Pres. Mercantile Mutual Fire Ins. Co. . . . . Box 1153, 723 Banigan Building, Providence, R. I. . . . Oct. 28, 1897.

Arthur F. Gray . . . . Architect and Mill Engineer . . . . . 53 State St., Room 509, Boston, Mass. . . . Oct. 18, 1900.

Samuel M. Green . . . . . Holyoke, Mass. . . . Apr. 24, 1902.

Edwin Farnham Greene Pres. Lockwood, Greene & Co. . . . . 93 Federal St., Boston, Mass. . . . Apr. 24, 1902.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . 326 So. Water St., Providence, R. I. . . . Oct. 25, 1895.

Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . Box 409, Fall River, Mass. . . . Oct. 28, 1897.

Walter Maxwell Hastings Principal Textile Dept. American School of Correspondence . . . . . 156 Tremont St., Boston, Mass. . . . Oct. 2, 1902.

Jerome Hill . . . . . Pres. Jerome Hill Cotton Co. . . . . 334 Front St., Memphis, Tenn. . . . Apr. 29, 1896.

Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.

Alfred K. Hobbs . . . Rubber, Leather and Mill Supplies . Manchester, N. H. . Oct. 18, 1900.

John Hogg . . . . . Smith, Hogg & Gardiner, 144 Essex St., Boston, Mass. . . . Apr. 27, 1899.

Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 25, 1895.
Henry S. Houghton, Sr., Mfr. Grids and Beaters, 61 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
Lewis T. Houghton . . Mfr. Thread Boards and Thread Guides . . . . . 997 Main St., Worcester, Mass. . . Sept. 26, 1901.
A. H. Howard . . . . Treas. Howard Bros. Mfg. Co. . . . . P. O. Box 54, Worcester, Mass. . . Sept. 26, 1901.
Frederic W. Howe . . Selling Agt. Crompton & Knowles Loom Works . . . . . Box 899, Providence, R. I. . . Apr. 24, 1902.
Lemuel R. Howe . . . Importer & Dealer in Dye Stuffs, Howe, Fuller & Trunkett, ... 157 Federal St., Boston, Mass. . . . Apr. 25, 1901.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 25, 1895.
Daniel Jackson . . . . Cotton Buyer B. B. and R. Knight, . Providence, R. I. . . Apr. 24, 1902.
David Jackson . . . . Gen. Mgr. Jackson Pat. Shell Roll Co., Pawtucket, R. I. . . Apr. 24, 1895.

Lawrence M. Keeler . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 26, 1901.
William B. Kehew . . The Kehew-Bradley Co., ... 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
John E. Kendrick . . . Vice-Pres. American Supply Co. . . . . Box 822, Providence, R. I. . . Oct. 5, 1899.
Frank B. Kenney . . . Kitson Machine Co. . . . . Lowell, Mass. . . . Oct. 5, 1899.

W. C. Langford . . . Salesman, . . . 86 Weybosset St., Providence, R. I. . . Apr. 27, 1899.
Josiah M. Lasell . . . Asst. Treas. Whitin Machine Works, Whitinsville, Mass. . Apr. 24, 1895.
Samuel D. Lawton . . Treas. Fall River Machine Co. . . . Fall River, Mass. . . Oct. 18, 1900.
John H. Lorimer . . . Builder of Textile Machines . . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 28, 1897.
Sanford E. Loring . . Con. Architect, 341 Delaware St., . Syracuse, N. Y. . . Apr. 24, 1902.
Stephen C. Lowe . . . Agt. John Hetherington & Sons, Ltd., ... 186 Devonshire St., Boston, Mass. . . . Oct. 25, 1895.
Francis E. Macomber . Mill Supplies . . . . 21 Pearl St., Boston, Mass. . . . . Apr. 26, 1900.
Fay H. Martin . . . . Pres. Textile Machinery Co. . . . . 66 State St., Boston, Mass. . . . . Sept. 26, 1901.
F. H. Maynard . . . . Gen. Bus. Mgr. Gen. Fire Extinguisher Co. . . . . Providence, R. I. . . Apr. 24, 1895.
John McCullough, . . . Cotton Waste Merchant . . . . . New Bedford, Mass. . April 25, 1901.
D. E. McGaw . . . . Gen. Mgr. Aragon Mills . . . . . Aragon, Ga. . . . . Oct. 18, 1900.
H. G. McKerrow . . . Textile Machinery Importer . . . . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
George H. Meader . . Steam Appliances . . 38 Pearl St., Boston, Mass. . . . Apr. 24, 1895.
John R. Mitchell . . . Mitchell-Bissell Co., 362 Bourse Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Charles B. Moore . . . Mgr. Knowles Steam Pump Works . . . . . 54 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.

Robert W. Neff . . . . Chemical Mfr. . . . . 22 India Sq., Boston, Mass. . . . Apr. 24, 1902.
John H. Nelson . . . . Treas. William Firth Co. . . . . .
. . . . . 67 Equitable Building, Box. 1460, Boston, Mass. . . . . Apr. 26, 1900.
William R. Noone . . . . . 102 South St., Boston, Mass. . . . Oct. 28, 1897.

Sidney B. Paine . . . General Electric Co., 200 Summer St., Boston, Mass. . . . Apr. 24, 1895.
William F. Parish, Jr. . Engineer, Vacuum Oil Co. (Technical Department) . .
. . . . . 101 Milk St., Boston, Mass. . . . . Apr. 24, 1902
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co. . . . . .
. . . . . 13 Gold St., New York, N. Y. . . Apr. 28, 1897.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . .
. . . . . 721 Banigan Bldg., Box 315, Providence, R. I. . . . Apr. 24, 1895.
Vladimir P. Polevoy . . Agent Jaroslav Cotton Mill, Russia . 120 Broadway, N. Y. Apr. 28, 1897.
Charles A. M. Praray . Chas. A. M. Praray & Co., Architect and Mill Engineer . .
. . . . . 832 and 833 Banigan Building, Providence, R. I. . . Apr. 28, 1897.
Theodore H. Price . . Cotton Dealer . . . . 71 Wall St., New York, N. Y. . . Oct. 2, 1902.

Charles F. Randall . . Expert in Textiles . . . . . .
. . . . . Room 350, Tremont Building, Boston, Mass. . . . Apr. 24, 1895.
Peleg A. Rhodes . . . Inspector of Cotton Mills . . . . . .
. . . . . P. O. Box 315, Providence, R. I. . . Oct. 5, 1899.
Richard H. Rice . . . Treas. Providence Engineering Works . . . . . .
. . . . . 521 So. Main St., Providence, R. I. . . Apr. 24, 1895.
E. R. Richardson . . . Asst. Treas. Howard & Bullough American Machine Co., Ltd.
. . . . . Box 678, Pawtucket, R. I. . . Apr. 26, 1900.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Inspection & Insurance Co. .
. . . . . 125 Milk St., Boston, Mass. . . . Apr. 24, 1895.
Louis E. Robinson . . Cotton Agent Sea Island Cotton . . . . . .
. . . . . 36 So. Water St., Providence, R. I. . . Oct. 28, 1897.
George I. Rockwood, . Mechanical Engineer, 62 Summer St., Worcester, Mass. . . Apr. 25, 1901.
E. A. Rusden . . . . Treas. and Gen. Mgr. Rusden Machine Co. . . . . .
. . . . . Warren, R. I. . . . Oct. 18, 1900.
John M. Russell . . . . Treas. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 25, 1895.

Dwight Seabury . . . Mill Engineer . . . 12 East Ave., Pawtucket, R. I. . . Apr. 25, 1901.
William N. Shaw . . . Treas. The Geo. W. Stafford Co. . . Readville, Mass. . . Apr. 24, 1902.
J. A. Shepherd . . . . Sales Agt. The Stirling Co. . . . . .
. . . . . 53 State St., Room 631, Exchange Building, Boston, Mass. . . . Oct. 18, 1900.
Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . .
. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.

George W. Stafford . . Pres. and Gen. Mgr. Geo. W. Stafford Co. . . . . Readville, Mass. . . Apr. 24, 1895.
H. E. Stafford . . . . Asst. Treas. Geo. W. Stafford Co. . Readville, Mass. . . Oct. 18, 1900.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 28, 1897.
William H. Stratton . . Mgr. Factory Insurance Association . . . . . 95 Pearl St., Hartford, Conn. . . Apr. 28, 1897.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ... 34 South Water St., Providence, R. I. . . Apr. 24, 1895.
John Sykes, J. P. . . . Pres. English Card Clothing Co. . . . . Acre House, Huddersfield, Eng. . Oct. 18, 1900.
Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Charles F. Taylor . . . Prop. Burgess Cop Tube Co., ... 15 Custom House St., Providence, R. I. . . Apr. 27, 1898.
George C. Tewksbury . Eastern Mgr. The Under-Feed Stoker Co. of America . . . . . 721 Exchange Bldg., Boston, Mass. Apr. 24, 1902.
James T. Thornton . . Vice-Pres. A. B. Pitkin Machinery Co. . . . . Providence, R. I. . . Oct. 18, 1900.
William V. Threlfall . . Agt. Saco and Pettee Machine Shops, Biddeford, Me. . . . Apr. 24, 1895.
Rienzi W. Thurston . Machinery Manufacturer . . . . . Fall River, Mass. . . Oct. 18, 1900.
H. A. Tillinghast, . . . Sec. and Treas. Granger Foundry & Mach. Co., ... Providence, R. I. . . Apr. 25, 1901.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . 257 West Exchange St., Providence, R. I. . . Sept. 22, 1896.
Allison W. Trafford . . Mfr. of Ring Travelers . . . . . 116 Pocasset St., Fall River, Mass. . . Apr. 26, 1900.
Arthur Turnbull . . . Mgr. John J. Keller & Co. (Incorporated) . . . . . 56 South Water St., Providence, R. I. . . Oct. 2, 1902.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Clement A. Wakefield . Selling Agt. Saco & Pettee Machine Shops, ... Biddeford, Me. . . . Apr. 25, 1901.
Justin A. Ware . . . . Crompton & Knowles Loom Works . Worcester, Mass. . . Oct. 25, 1895.
J. F. Warren . . . . . Treas. J. F. & W. H. Warren Co. . . . . 44 Vine St., Worcester, Mass. . . Apr. 24, 1902.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes for Textile Manufg. . . . . Box 996, Lowell, Mass. . . . Oct. 25, 1895.
Robert C. Webster . . Mgr. Barber & Colman . . . . . 11 Pemberton Sq., Boston, Mass. . . . Apr. 24, 1902.
Stephen M. Weld, . . Cotton Buyer . . . . . 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
W. W. White . . . . Agent Holyoke Machine Co. . . . Worcester, Mass. . . Apr. 27, 1899.

G. Marston Whitin	Treas. Whitin Machine Works	Whitinsville, Mass.	Apr. 24, 1895.
Fred A. Wilde	Gen. Mgr. The A. T. Atherton Machine Co.	Prairie Ave., Pawtucket, R. I.	Apr. 28, 1897.
Erving Yale Woolley	Stoddard, Haserick, Richards & Co.	152 Congress St., Boston, Mass.	Apr. 24, 1895.

Honorary Members	4
Active Members	539
Associate Members	156
Total Membership	699

MEMBERS OF THE ASSOCIATION,

Oct. 2, 1902.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shops.
Biddeford	Clement A. Wakefield	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works
Lisbon	W. H. Miles	Farwell Mills.
Portland	Lyman M. Cousens	Dana Warp Mills.
Saco	James G. Garland	
Saco	Elmer E. Page	York Manufg. Co.
Sanford	Louis B. Goodall	Goodall Worsted Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	George A. Hurd	76 Broadway.
Dover	Herbert W. Owen	Cocheco Manufg. Co.

Exeter	George E. Kent	Exeter Manufg. Co.
Exeter	Hervey Kent	Exeter Manufg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.
Hooksett	Stephen N. Bourne	Dundee Mills.
Manchester	Henry Deane Bourne	Hooksett Manufg. Co.
Manchester	French Campbell	75 Granite St.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Alfred K. Hobbs	Rubber, Leather and Mill Supplies.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	John K. Russell	476 Hall St.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Milford	Frank E. Kaley	Morse & Kaley Manufg. Co.
Nashua	William D. Cadwell	Nashua Manufg. Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Mills.
Penacook	F. E. Wattles	Boscawen Mills.
Peterboro	Albert W. Noone	Jos. Noone's Son's Co.
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	Emil Kipper	Renfrew Mfg. Co. and Windsor Print Works.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	L. B. Renfrew	Renfrew Mfg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Belmont	John Kilburn	
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Boston	Charles B. Amory	Hamilton Mfg. Co.
Boston	Frederic Amory	Nashua Mfg.Co. and Jackson Mfg.Co
Boston	Eugene C. Andres	577 John Hancock Building.

Boston	Edward Atkinson	Boston Mfrs. Mut. Fire Ins. Co.
Boston	E. W. Atkinson	Stoddard, Haserick, Richards & Co.
Boston	Nathaniel F. Ayer	Farwell Bleachery.
Boston	Edwin Barnes	Wm. Firth Co.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	F. H. Bishop	Universal Winding Co.
Boston	Arthur T. Bradlee	Harding, Whitman & Co.
Boston	J. Payson Bradley	The Kehew-Bradley Co.
Boston	S. Parker Bremer	Monadnock Mills.
Boston	Henry Gordon Brinckerhoff	Green Fuel Economizer Co.
Boston	John H. Burghardt	Page Belting Co.
Boston	Frank B. Comins	American Moistening Co.
Boston	Sidney Coolidge	Stark Mills.
Boston	Alphonse S. Covel	Tremont and Suffolk Mills.
Boston	Augustus De Cort	Beacon Mfg. Co.
Boston	P. Y. DeNormandie	Pepperell Mfg. Co.
Boston	Frederic C. Dumaine	Amory Mfg. Co.
Boston	John O. DeWolf	Mech. Engineer.
Boston	Ambrose Eastman	53 State St., Room 904.
Boston	William Dresser Edwards	Buffalo Forge Co.
Boston	William Firth	Am. Moist. Co. and Wm. Firth Co.
Boston	Joseph Fossel	Cotton Machinery Expert.
Boston	Alfred M. Goodale	Boston Mfg. Co.
Boston	Arthur F. Gray	53 State St., Room 509.
Boston	Edwin Farnham Greene	Lockwood, Greene & Co.
Boston	Richard H. Hill	Jas. Hunter Machine Co.
Boston	William H. Hill	Windsor Co. and Renfrew Mfg. Co.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	Smith, Hogg & Gardiner.
Boston	Henry S. Howe	Dry Goods Commission.
Boston	Lemuel R. Howe	Howe, Fuller & Trunkett.
Boston	Charles W. Hubbard	Ludlow Mfg. Associates.
Boston	Joseph B. Jamieson	New England Cotton Yarn Co.
Boston	William B. Kehew	The Kehew-Bradley Co.
Boston	Evan Arthur Leigh	70 Kilby St.
Boston	William C. Lovering	Whittenton Mfg. Co.
Boston	A. Lawrence Lowell	53 State St.
Boston	Herbert Lyman	P. O. Box 1717.
Boston	Francis E. Macomber	21 Pearl St.
Boston	Charles T. Main	Dean & Main.
Boston	Fay H. Martin	Textile Machinery Co.
Boston	Fred C. McDuffie	Everett Mills and York Mfg. Co.
Boston	H. G. McKerrow	31 State St.
Boston	George H. Meader	38 Pearl St.
Boston	Charles B. Moore	Knowles Steam Pump Works.
Boston	George B. Morison	Ballou Yarn Co.
Boston	Robert W. Neff	Chemical Mfr.

Boston	John H. Nelson	Wm. Firth Co.
Boston	William R. Noone	102 South St.
Boston	Sidney B. Paine	General Electric Co.
Boston	William F. Parish, Jr.	Vacuum Oil Co. (Tech. Dept.)
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Henry Smith Pritchett, LL.D.	Mass. Institute of Technology.
Boston	Charles F. Randall	350 Tremont Building.
Boston	Walter Rigby	Stoddard, Haserick, Richards & Co.
Boston	Charles E. Riley	C. E. Riley & Co.
Boston	C. E. Roberts	Hartford Steam Boiler Insp. & Ins.Co.
Boston	Arnold B. Sanford	American Cotton Yarn Exchange.
Boston	J. Herbert Sawyer	93 Federal St.
Boston	George H. Shapley	Silver Lake Co.
Boston	J. A. Shepherd	The Stirling Co.
Boston	William F. Sherman	27 State St.
Boston	George C. Tewksbury	The Under-Feed Stoker Co. of America.
Boston	James P. Tolman	Samson Cordage Works.
Boston	Edward B. Townsend	Warwick Mills.
Boston	Frank H. Underwood	Dodge Mfg. Co.
Boston	Frederick T. Walsh	Thomas Leyland & Co.
Boston	Robert C. Webster	Barber & Colman.
Boston	Stephen M. Weld	89 State St.
Boston	William Whitman	Arlington Mills.
Boston	Franklin D. Williams	Fiskdale Mills.
Boston	Erving Yale Woolley	Stoddard Haserick, Richards & Co.
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Canton	Willis S. Shepard	Amer. Net & Twine Co.
Chicopee Falls	G. H. T. Babbitt	Chicopee Mfg. Co.
Chicopee Falls	Henry A. Bailey	Chicopee Manufg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	John R. Rostron	Lancaster Mills.
Clinton	George P. Taylor	Danielsonville Cotton Co.
Clinton	George W. Weeks	330 Church St.
Easthampton	George A. Ayer	West Boylston Co.
East Hampton	William B. Fittz	
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Agt. for Card Clothing Manufr.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery Co.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Richard Borden Mfg. Co.
Fall River	Thomas J. Borden	326 North Main St.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	George A. Chace	Bourne Mills.
Fall River	Simeon B. Chase	King Philip Mills.
Fall River	John A. Collins	American Linen Co.

Fall River	Bradford D. Davol	Barnard Manufg. Co.
Fall River	Frank H. Dwelly	Tecumseh Mills.
Fall River	David H. Dyer	D. H. Dyer & Son.
Fall River	William Evans	Wampanoag Mills.
Fall River	Charles F. Farrar	22 Coggeshall St.
Fall River	John T. Fyans	Fyans, Frazer & Blackway Co.
Fall River	Arthur M. Hamilton	Hargraves and Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	Walter Maxwell Hastings	American School of Correspondence,
Fall River	Samuel E. Hathaway	Fall River Iron Works Co.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	Yarn Broker.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co.
Fall River	William P. Holt	Barnaby Mills.
Fall River	George H. Law	Merchants' Mfg. Co.
Fall River	Samuel D. Lawton	Fall River Machine Co.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	Arthur H. Mason	Barnaby Mfg. Co.
Fall River	John R. Mason	523 Broadway.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	James A. McLane	Davis Mills.
Fall River	J. Edward Osborn	American Linen Co.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	John Bion Richards	Davis Mill.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	John Sullivan	Union Cotton Manufg. Co.
Fall River	Timothy Sullivan	Davol Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	Rienzi W. Thurston	Machinery Manufacturer.
Fall River	Horace W. Tinkham	Robeson Mills.
Fall River	M. J. Toohey	Mfr. Rope, Twine and Banding.
Fall River	Allison W. Trafford	Mfr. Ring Travelers.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Joseph Watters	Osborn Mills.
Fisherville	Albert W. Dimick	Fisher Mfg. Co.
Fisherville	Charles W. Fisher	Fisher Mfg. Co.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	Grant Yarn Co.
Fitchburg	John Leiper	Fitchburg Worsted Mills.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.

Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomson	Parkhill Manufg. Co.
Great Barrington	Jno. H. C. Church	Monument Mills.
Holyoke	Samuel M. Green	
Holyoke	Ernest Lovering	Lyman Mills.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	William F. Draper, Jr.	Draper Co.
Hopedale	Frank J. Dutcher	Shaw Stocking Co.
Housatonic	T. G. Ramsdell	Monument Mills.
Hyde Park	Calvin H. Lee	Readville Cotton Mills.
Hyde Park	T. B. Stevenson	Readville Cotton Mill.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	Metallic Drawing Roll Co.
Ipswich	James W. Brown	Box 312.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	Emmons Loom Harness Co.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Box 28.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	Walter H. Summersby	Atlantic Cotton Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Leicester	Charles A. Denny	American Card Clothing Co.
Linwood	Amos G. Maddox	Linwood Mill.
Linwood	Fred B. Whitin	Uxbridge Cotton Mills.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Rim Pulleys and Wood Working Machinery.
Lowell	Clarence N. Childs	Hamilton Mfg. Co.
Lowell	John J. Connell	Tremont and Suffolk Mills.
Lowell	Richard Cowell	Boott Cotton Mills.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Daniel Cushing & Co.
Lowell	Albert W. Danforth	Shanghai Cotton Cloth Mills.
Lowell	Albert Deabill	Lowell Hosiery Co.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	William Ambrose Eastman	Lowell Hosiery Co.

Lowell	T. C. Entwistle	T. C. Entwistle Co.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	Sumner S. Gould	Lowell Branch Am. Card Clo. Co.
Lowell	William E. Hall	Shaw Stocking Co.
Lowell	Otis L. Humphrey	Cotton Dept. Lowell Textile School.
Lowell	A. W. Hunking,	374 Stevens St.
Lowell	Frank B. Kenney	Kitson Machine Co.
Lowell	Charles F. Libby	Shaw Stocking Co.
Lowell	Alvin S. Lyon	Bigelow Co.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimack Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	Edwin A. Robinson	Tremont and Suffolk Mills.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Earl A. Thissell	47 Mt. Vernon St.
Lowell	Ariel C. Thomas	Boott Cotton Mills.
Lowell	Charles T. Upton	63 Mt. Vernon St.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lynn	Henry B. Sprague	Boston Woven Hose and Rubber Co
Lynn	C. J. H. Woodbury	61 Commercial St.
Medford	Henry B. Ashton	S. A. Felton & Son Co.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Methuen	Alfred Sagar	Arlington Cotton Mills.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Francis H. Rice	Holbrook Mfg. Co.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
Millbury	Eben C. Willey	Holbrook Mfg. Co.
Millis	W. Marshall Taylor	National Flax Fibre Co.
New Bedford	Christopher P. Brooks	New Bedford Textile School.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Nathaniel B. Kerr	Butler Mill.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	Stephen C. Lowe	John Hetherington & Sons, Ltd.
New Bedford	Frederick B. Macy	Soule Mills.
New Bedford	John McCullough	Cotton Waste Merchant.
New Bedford	John Neild	Grinnell Mfg. Co.
New Bedford	Albert R. Pierce	Pierce Mfg. Corp.
New Bedford	Andrew G. Pierce, Jr.	Pierce Mfg. Corp.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	James O. Thompson, Jr.	Wamsutta Mills.

New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.
New Bedford	Benjamin Wilcox	City and Bristol Mfg. Co.
Newburyport	O. D. Drew	Peabody Mfg. Co.
Newton	Josiah G. Coburn	99 Washington St.
Newtonville	Oscar B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Edmund E. Blake	Saco & Pettee Machine Shops.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. Paul Snelling	Saco and Pettee Machine Shops.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.
North Adams	Charles W. Dennett	Johnson-Dunbar Mills Co.
North Adams	Henry C. Phillips	Greylock Mills.
Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Readville	William N. Shaw	George W. Stafford Co.
Readville	George W. Stafford	George W. Stafford Co.
Readville	H. E. Stafford	George W. Stafford Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullan	Naumkeag Steam Cotton Co.
Salem	Henry Osgood	P. O. Box 204.
Salem	Nathaniel G. Simonds	Naumkeag Steam Cotton Co.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
Somerville	Albert Birch	Somerville Machine Works.
South Hadley Falls	William R. Hill	Glasgow Manufg. Co.
Springfield	Joseph M. Dunham	43 Edwards St.
Springfield	Nelson Whittier	Whittier Mills.
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	Peter H. Corr	Greenwich Bleachery.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	P. T. Creed	Hopewell Mills.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mills.
Taunton	Andrew J. Currier	Cohannet and Nemasket Mills.
Taunton	Herbert Fisher	
Taunton	Jesse A. Knight	Cohannet Mills.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	Canoe River Mills.
Taunton	Joseph S. Tidd	Oakland Mills.
Thorndike	Charles H. Hobbs	Thorndike Co.

Three Rivers	Roscius C. Newell	Palmer Mill.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Walnut Hill	Benjamin M. Earle	Merchants Dye Works.
Waltham	Charles E. Getchell	35 Willow St.
Waltham	Arthur H. Gulliver	Boston Mfg. Co.
Ware	George E. Tucker	The Otis Co.
Webster	E. P. Morton	Stevens Linen Works.
West Warren	George A. Moody	West Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Melvin H. Coffin	Whitin Machine Works.
Whitinsville	Lawrence M. Keeler	Whitin Machine Works.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Winchester	George H. Sayward	
Worcester	Joseph P. Battles	Crompton & Knowles Loom Works.
Worcester	George Crompton	
Worcester	Henry F. Harris	W. Boylston Mfg. Co.
Worcester	Lewis T. Houghton	997 Main St.
Worcester	A. H. Howard	Howard Bros. Mfg. Co.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works.
Worcester	Geo. I. Rockwood	62 Summer St.
Worcester	John M. Russell	Crompton & Knowles Loom Works.
Worcester	Justin A. Ware	Crompton & Knowles Loom Works.
Worcester	J. F. Warren	J. F. & W. H. Warren Co.
Worcester	W. W. White	Holyoke Machine Co.
Worcester	Alfred N. Whiting	L. M. Harris Mfg. Co.

RHODE ISLAND.

Allenton	R. A. Gray	Rodman Manufg. Co.
Ashton	Charles H. Collins	Berkeley Co.
Ashton	Robert Stewart	Lonsdale Co.
Bayside	Abel T. Atherton	Machine Maker.
Central Falls	Louis B. Barker	United States Cotton Co.
Central Falls	David Grove	United States Cotton Co.
Central Falls,	B. F. G. Linnell,	Yarns, Threads and Twines.
Centreville	James T. Ferguson	Warwick Mills.
Centreville	Robert B. Treat	Centreville Cotton Mills.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Fiskville	James Gee	Interlaken Dye Works.

Forestdale	Alphonso F. White	Forestdale Mfg. Co.
Georgiaville	A. E. Bosworth	Bernon Mills.
Lonsdale	Edward A. Mongeon	Lonsdale Mills.
Manville	A. Tenny White	Manville Co.
Natick	Charles M. Holmes	Natick Mills.
Pawtucket	V. T. Barber	Slater Cotton Co.
Pawtucket	William Washington Blades,	Lorraine Mfg. Co.
Pawtucket	Robert Burgess	Slater Cotton Co.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	Henry C. Dexter	Greene & Daniels Mfg. Co.
Pawtucket	Fred W. Easton	Easton & Burnham Machine Co.
Pawtucket	D. A. Everly	Cotton Mfr.
Pawtucket	John J. Hart	Charlton Manufg. Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	E. R. Richardson	Howard & Bullough American Machine Co., Ltd.
Pawtucket	Dwight Seabury	12 East Ave.
Pawtucket	S. Willard Thayer	Dexter Yarn Co.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Phenix Mill.
Pontiac	Walter B. Hall	Pontiac Mill, B. B. and R. Knight.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	Fletcher Mfg. Co.
Providence	H. C. Atwood	Williamsville Manufg. Co.
Providence	George R. Babbitt	American Oil Co.
Providence	Edward R. Ballou	Ballou Yarn Co.
Providence	Truman Beckwith	Dyerville Manufg. Co.
Providence	J. Frank Braids	Charles S. Bush Co.
Providence	D. Russell Brown	Brown Bros. Co.
Providence	H. Martin Brown	U. S. Bobbin & Shuttle Co.
Providence	E. C. Bucklin	Interlaken Mills.
Providence	Fred N. Bushnell	Narragansett Electric Light Co.
Providence	Albert L. Calder, 2nd	P. O. Box 206.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Frederick I. Dana	Thomas Phillips Co.
Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co. and Ponemah Mills.
Providence	E. W. Davenport	Crompton & Knowles Loom Works.
Providence	F. C. Fletcher	Lawton Spinning Co.
Providence	J. Herbert Foster	10 South Water St.
Providence	William Gammell	Berkeley Co.
Providence	Rufus B. Goff	Standard Mill Supply Co.

Providence	William S. Granger	Granger Foundry & Machine Co.
Providence	Henry T. Grant, Jr.	Mercantile Mutual Fire Insurance Co.
Providence	John H. Hambly	Quidnick Mfg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co.
Providence	Elisha H. Howard	Cotton Goods Broker.
Providence	Frederic W. Howe	Crompton & Knowles Loom Works.
Providence	Daniel Jackson	B. B. & R. Knight.
Providence	John E. Kendrick	American Supply Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Webster Knight	B. B. & R. Knight's Mills.
Providence	W. C. Langford	86 Weybosset St.
Providence	Charles Warren Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Box 973.
Providence	A. T. Malcolmson	C. Bischoff & Co.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	Thomas Mayor & Son.
Providence	Charles H. Merriman, Jr.	Social Mfg. Co.
Providence	William C. Peirce	Elizabeth Mills.
Providence	Reuben Pilling, Jr.	30 Hudson St.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Chas. A. M. Praray & Co.
Providence	Peleg A. Rhodes	P. O. Box 315.
Providence	Richard H. Rice	Providence Engineering Works.
Providence	George W. Robbins	Dyerville Mfg. Co.
Providence	Louis E. Robinson	36 So. Water St.
Providence	Richard W. B. Sanderson	G. S. Lings & Co.
Providence	F. C. Sayles	Baltic Mills Co.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Harry M. Smith	Standard Mill Supply Co.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert Rennie Taft	P. O. Box 1443.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	Burgess Cop Tube Co.
Providence	D. M. Thompson	B. B. & R. Knight's Mills.
Providence	James T. Thornton	A. B. Pitkin Machinery Co.
Providence	H. A. Tillinghast	Granger Foundry & Machine Co.
Providence	A. Curtis Tingley	National Ring Traveler Co.
Providence	W. O. Todd	Lawton Spinning Co.
Providence	Arthur Turnbull	John J. Keller & Co.
Providence	William P. Vaughan	Putnam Mfg. Co.
Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen Mills.
Valley Falls	Edward B. Jennings	Samoset Co.
Valley Falls	John W. Ramsbottom	Samoset Co.
Warren	E. A. Rusden	Rusden Machine Co.
Warren	Arnold Schaer	Warren Manufg. Co.

Westerly	Robert Dow	Solway Mills.
Westerly	A. E. Henry	Solway Mills.
Wickford	Joseph Warren Greene	
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	Harry K. Drew	Clinton Mfg. Co.
Woonsocket	William Halliwell	Providence and Woonsocket Mills of the Lawton Spinning Co.
Woonsocket	Edward W. Houghton	Globe Mill.
Woonsocket	Henry S. Houghton, Sr.	61 Pond St.
Woonsocket	Albert C. Hoy	
Woonsocket	William N. Kimball	Social and Nourse Mills.
Woonsocket	Albert F. Knight	39 Main Street.
Woonsocket	William A. Robinson	Manville Co.
Woonsocket	Charles E. Thomas	Forestdale Mfg. Co.

CONNECTICUT.

Baltic	Harold Lawton	Baltic Mills Co.
Danielson	Henry D. Martin	Danielson Cotton Mfg. Co.
Danielson	James Herbert Smith	Quinebaug Co.
Hartford	William H. Stratton	Factory Insurance Association.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	C. H. Truesdell	Attawaugan Co.
Middletown	Joseph Merriam	Springfield Webbing Co.
Middletown	J. F. Powers	Spinning Mill.
Montville	Emory S. Rathbun	Pequot Mills.
Moosup	William J. Cray	Aldrich Mfg. Co.
New Haven	George S. Barnum	The Bigelow Co.
New London	Louis L. Hohn	Cor. Conn. Ave. and McDonald St.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	
Norwich	C. H. Frisbie	Attawaugan Co.
Norwich	W. G. Henderson	Shetucket Co.
Norwich	John F. Reardon	Falls Co.
Norwich	Charles D. White	Uncasville Manufg. Co.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Uncasville	Robert G. McMeehan	Uncasville Mfg. Co.
Voluntown	George T. Briggs	The Briggs Mfg. Co.
Wauregan	James A. Atwood	Wauregan Co. & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Co.

Willimantic	Dickerson G. Baker	American Thread Co.
Willimantic	E. S. Boss	Willimantic Linen Co.
Willimantic	Joseph Mercer	Willimantic Cotton Mills Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willowvale Bleaching Co.
Cohoes	David S. Johnston	Cohoes Iron Foundry & Machine Co.
Cohoes	George E. Prest	No. 1 Harmony Mill.
Cohoes	Harry B. Prest	Harmony Mills.
Cohoes	John E. Prest	Harmony Mills.
Cohoes	William H. Robinson	No. 3 Harmony Mill.
Cohoes	Albion K. Searls	Ogden Mill (Harmony Mills).
Elmira	William H. Bilbrough	Elmira Knitting Mills and Conewawah Spinning Co.
Jamestown	Thomes Henry Smith	Jamestown Cotton Mill.
Newburgh	William J. Hadfield	Newburgh Steam Mills.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co.
New York City	D. C. Ball	27 William St.
New York City	Percy H. Brundage	49 Wall St.
New York City	Albert C. Case	American Cotton Co.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	C. C. Cowan	27 William St.
New York City	Arthur C. Freeman	Rusden Machine Co.
New York City	Ernest L. Hill	Renfrew Mfg. Co.
New York City	Arthur B. Mann	J. H. Martin & Co.
New York City	Arthur Parkinson	Arabol Mfg. Co.
New York City	Duncan D. Parmly	Johnson Mfg. Co. & Dunbar Mills Co.
New York City	Vladimir P. Polevoy	Jaroslav Cotton Mill.
New York City	Theodore H. Price	Cotton Dealer.
New York City	George A. Wies	Eureka Fire Hose Co.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
Syracuse	Sanford E. Loring	341 Delaware St.
Upper Troy	A. G. Harris	W. H. Draper & Son.
Utica	George DeForest	Utica Steam Cotton Mills.
Utica	James B. Duggan	Utica Bleaching and Finishing Co.
Utica	George E. Farrell	Utica Spinning Co.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica	Pardon B. Sanford	Utica Spinning Co.
Utica	John B. Wild	Oneita Knitting Mills.

NEW JERSEY.

East Newark	Halsey Connett	Clark Mile End Spool Cotton Co.
Gloucester City	Philip H. Fowler	417 Monmouth St.
Gloucester	George W. Turner	Argo Mills Co.
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Jersey City	B. L. Stowe	Eureka Fire Hose Co.
Millville	C. Enos Bean	Millville Mfg. Co.
Millville	A. W. Brainerd	May's Landing Water Power Co. and Millville Mfg. Co.
Newark	William H. Loftus	Clark Thread Co.
New Brunswick	William Henry Hobbs	Johnson & Johnson Co.
New Brunswick	William H. Ritter	Johnson & Johnson.
Passaic	Dudley T. Lyall	Brighton Mills.
Passaic	William L. Lyall	Brighton Mills.
Paterson	John W. Ferguson	Paterson Nat. Bank Bldg.

PENNSYLVANIA.

Chester	W. T. Galey	Aberfoyle Manufg. Co.
Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
Philadelphia	Robert Beatty	Robt. Beatty & Co.
Philadelphia	T. Ashby Blythe	Ashby Cotton Mills.
Philadelphia	Alfred H. Burnham	Glasgow Mills.
Philadelphia	Harry W. Butterworth	H. W. Butterworth & Sons.
Philadelphia	James Butterworth	H. W. Butterworth & Sons.
Philadelphia	Byron F. Card	300 Chestnut St.
Philadelphia	Frederick A. Downes	Factory Mutual Fire Insurance Cos.
Philadelphia	Edward W. France	Philadelphia Textile School.
Philadelphia	Merrill A. Furbush	2015 North 33rd St.
Philadelphia	Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford.
Philadelphia	Otto Goetze	Glasgow Mills.
Philadelphia	John T. Greenwood	R. Greenwood & Bault.
Philadelphia	Henry S. Grove	Argo Mills Co.
Philadelphia	W. C. Houston	Hope Mills Mfg. Co.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave. and 11th St.
Philadelphia	John R. Mitchell	Mitchell-Bissell Co.
Philadelphia	Edward H. Sanborn	Cold Spring Bleach. & Fin. Works.
Philadelphia	Theodore C. Search	Cold Spring Bleach. & Fin. Works.
Philadelphia	William E. Winchester	Philadelphia Textile School.
Philadelphia	George Wood	Millville Mfg. Co.
Philadelphia	John P. Wood	Spring Garden and 22nd Sts.
Philadelphia	Oscar W. Wood	Germantown Spinning Co.
Yardley	R. Irving Tobey	Cold Spring Bleaching and Finishing Works.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.
Wilmington	Daniel Moore Bates	Joseph Bancroft & Sons Co.
Wilmington	Colin C. Bell	American Vulcanized Fibre Co.

MARYLAND.

Baltimore	James A. Gary	Alberton Mills.
Baltimore	Charles K. Oliver	Continental Bldg.
Ilchester	Samuel F. Patterson	Thistle Mills Co.

VIRGINIA.

Lynchburg	Theop. W. Wilmarth	1205 Floyd St.

NORTH CAROLINA.

Asheville	William Whittam, Jr.	The William Whittam Textile Co.
Charlotte	S. B. Alexander, Jr.	S. B. Alexander, Jr., Co.
Charlotte	Henry C. Clark	Charlotte Supply Co.
Charlotte	R. M. Miller, Jr.	Elizabeth Mills.
Charlotte	Daniel A. Tompkins	Atherton Mills.
Cooleemee	Edward W. Thomas	Erwin, Pearl, Durham, Alpine and Cooleemee Cotton Mills.
Durham	O. W. Stites	Elliott Fuel Saving Co.
Fayetteville	Walter L. Holt	Holt-Morgan Mills.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Hope Mills	Frank H. Cotton	Hope Mills Mfg. Co.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Winston-Salem	John W. Fries	F. & H. Fries.

SOUTH CAROLINA.

Chester	William G. Nichols	Springstein Mills.
Columbia	Louis I. Guion	Columbia Mills Co.
Columbia	James Sumter Moore	Olympia & Richland Cotton Mills.
Columbia	W. H. Rose	Granby Cotton Mills.
Columbia	W. B. Smith Whaley	Richland & Granby Cotton Mills.
Fort Mill	Farquharson J. Muir	Fort Mill Mfg. Co. & Millfort Mill Co.
Gaffney	H. D. Wheat	Gaffney Mfg. Co. and Orient Mfg. Co.
Graniteville	T. H. Rennie	Graniteville Mfg. Co.
Greenville	James R. Pearce	Monaghan Mills.
Lancaster	Leroy Springs	Lancaster Cotton Mills.

Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Laurens	O. B. Parker	Laurens Cotton Mills.
Newbury	Edward B. Wilbur	Mollohon Mfg. Co.
Pelham	D. G. Sunderland	The Pelham Mills.
Pelzer	B. F. Guy	Pelzer Manufg. Co.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.
Union	T. C. Duncan	Union Cotton Mills.

GEORGIA.

Aragon	D. E. McGaw	Aragon Mills.
Atlanta	Samuel A. Carter	Gate City Cotton Mills.
Atlanta	C. E. W. Dow	Am. Moist. Co. and Wm. Firth Co.
Atlanta	W. L. Draper	Dodge Mfg. Co.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	Harry W. Kimball	Fulton Bag and Cotton Mills.
Atlanta	William M. Nixon	Atlanta Woolen Mills.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	John W. Chafee	The Sibley Mfg. Co.
Augusta	T. I. Hickman	Graniteville Mfg. Co.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Augusta	Eugene F. Verdery	Warren Mfg. Co.
Augusta	James P. Verdery	Enterprise Mfg. Co.
Chattahoochee	W. R. B. Whittier	Whittier Mills.
Columbus	E. N. Clemence	Eagle & Phenix Mills.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.
Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	George W. Towne	Columbus Power Co.
East Point	Edward C. Beach	Gate City Cotton Mills.
Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
Gainesville	J. Colby Lewis	Vesta Cotton Mills.
Lawrenceville	Albert E. McDonald	Lawrenceville Mfg. Co.
Lindale	Henry P. Meikleham	Mass. Mills in Georgia.
Macon	W. H. Richmond	Bibb Mill No. 2.
Macon	Broadus E. Willingham	Willingham Cotton Mills.
West Point	Scott Maxwell	Lanett Cotton Mills.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	Jerome Hill	Jerome Hill Cotton Co.
Nashville	T. B. Dallas	Dallas Mfg. Company.

ILLINOIS.

Chicago	Frederick A. Flather	McCormick Harvesting Machine Co.

MISSISSIPPI.

Starkville	Arthur Whittam	John M. Stone Cotton Mills and Miss. Textile School.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.
Louisville	Philip S. Tuley	Louisville Cotton Mills Co.

ALABAMA.

Birmingham	B. B. Comer	Avondale Cotton Mills.
Cordova	Joseph O. Hannum	Indian Head Mills of Ala.
Huntsville	T. W. Pratt	West Huntsville Cotton Mill Co.
Langdale	Charles M. Sears	West Point Mfg. Co.
Pell City	Edward T. Garsed	Pell City Mfg. Co.

TEXAS.

Galveston	Lawrence V. Elder	Galveston City Cotton Mills.

CANADA.

Province of Ontario.

Cornwall	S. Greenwood	The Canadian Colored Cotton Mills Co. Ltd.
Hamilton,	Charles Owen Dexter	The Canadian Colored Cotton Mills Co., Ltd
Hamilton,	James M. Young	Hamilton Cotton Co.
Ottawa	Louis Simpson	Victoria Chambers.

Province of Quebec.

Hochelaga	W. S. Hume	176 Notre Dame St.
Montreal	Alfred Hawkesworth	Merchants Cotton Co.
Montreal	Fred Hawkesworth	Merchants Cotton Co.
Montreal	D. K. McLaren	751 Craig St.
Montreal	A. B. Mole	Dominion Cotton Mills Co.
Valleyfield	Ernest E. Clark	Montreal Cotton Co.
Valleyfield	Fred Lacey	Montreal Cotton Co.
Valleyfield	Charles H. Potter	Montreal Cotton Co.

NEW BRUNSWICK.

Milltown	Lewis Dexter, Jr.	The Canadian Colored Cotton Mills Co., Ltd.
St. John	John B. Cudlip	Cornwall and York Cotton Mills Co.
St. John	John H. Parks	John H. Parks & Co.

ENGLAND.

Matlock, Derbyshire,	John Edward Lawton . .	American Thread Co.
Huddersfield . . .	John Sykes	English Card Clothing Co.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	19
New Hampshire	31
Vermont	1
Massachusetts	324
Rhode Island	117
Connecticut	32
New York	36
New Jersey	14
Pennsylvania	27
Delaware	3
Maryland	3
Virginia	1
North Carolina	14
South Carolina	17
Georgia	29
Tennessee	3
Illinois	1
Mississippi	1
Louisiana	1
Kentucky	2
Alabama	5
Texas	1
Province of Ontario	4
Province of Quebec	8
New Brunswick	3
England	2
	699

IN MEMORIAM.

WILLIAM D. CADWELL.

WILLIAM D. CADWELL was born at Montpelier, Vt., October 16, 1834, and early in life he was employed in the machine shop of the Merrimack Cotton Mills at Lowell, and at the age of 32 he came to the Nashua Manufacturing Co. of Nashua, as master machinist, and two years later was made superintendent in the corporation which he held until 1871 when he became agent of the Jackson Company, where he made many changes and extensions of the plant.

In 1891 he was made agent of the Nashua Manufacturing Company, holding both positions until October, 1900, when he was succeeded at the Jackson Company by his son, WILLIAM H. CADWELL. He was also treasurer of the Nashua Gas Company from 1874 until its consolidation with another company. He was president of the Masonic Building Association, a member of the Currier Building Association, a director of the Pennichuck Water Company, of the Nashua Board of Trade, and the Indian Head National Bank. He was a member of Masonic bodies and also of the American Society of Mechanical Engineers.

Mr. CADWELL was peculiarly successful in the administration of mills, having the confidence of the help, and the force to direct without needless irritation. In business affairs he had the happy faculty of rapidly reaching a comprehensive opinion.

He was highly esteemed for his sound judgment.

He died October 10, 1902, and is survived by his widow, a daughter, Miss BLANCHE CADWELL and a son WILLIAM H. CADWELL, agent of the Jackson Company. He became a member of this Association April 19, 1871.

CHARLES DENNETT McDUFFIE.

CHARLES DENNETT MCDUFFIE was born in Rochester, N. H., March 4, 1829, and died at Manchester, N. H., July 5, 1902, after a prominent and active life in cotton manufacturing. In his early life he was employed in mills in Lowell and later was one of the pioneers to the California coast where he remained but a few years, and returning, became an overseer at the Naumkeag Cotton Mills at Salem until 1868 when he was superintendent of the Whittendon Manufacturing Company at Taunton, Mass., until 1875, and then he was agent of the Everett Mills at Lawrence until October, 1880, which position he left for that of agent at the Manchester Mills at Manchester, N. H.

He was a man of unusual mental capacity, thorough in his knowledge of the details of cotton manufacturing, and also a judge of human nature which made him a natural leader and well qualified for the positions of trust which he occupied. His mature judgment was much sought by manufacturing and financial corporations, but the demands of a business life allowed but few official positions connected with these organizations. He was a member of the Textile Club in which organization he had served as president, and of the Home Market Club of which he was one of the vice-presidents.

At Manchester he was trustee of the Public Library, president of the Manchester Savings Bank and a member of the Board of Trade. He was a member of the Star King Lodge and Winslow

Lewis Commandery at Salem, Mass. He was married to LAURA B. DURGIN of Lowell, Mass., who survives him, and leaves two sons, FRED C. MCDUFFIE of Lawrence, Mass. the treasurer of the Everett Mills of Lawrence, and of the York Manufacturing Co. at Saco, Maine, and CHARLES HENRY MCDUFFIE, who is connected with the Manchester Mills at Manchester, N. H. He became a member of the New England Cotton Manufacturers' Association April 21, 1869 and was a constant attendant at the meetings.

His contributions to the meetings were upon the subjects of purchases of cotton, and upon the duties of overseers.

GEORGE W. WEEKS.

GEORGE W. WEEKS was born at Waltham, Mass., Feb. 23, 1838, and moved with his parents to Clinton in 1849, where his father was superintendent of the Boylston Mill of the Lancaster Mills. When he was 13 he entered the Lancaster Mills and was never employed elsewhere. He became successively clerk and paymaster, and in 1861, superintendent, and in 1877, agent, on the death of his predecessor, Mr. FRANKLIN FORBES.

He was married on Feb. 12, 1867, to Miss MARTHA A. STEARNS, who died a few months later. He was one of the most prominent of the cotton manufacturers in the line of ginghams, and was on the alert for the introduction of new and improved methods of manufacturing and dyeing. He was the inventor of the automatic spindle band machine and absorbent cotton. He extended the mills very largely during his term of office. In addition to these labors, he had educated himself by reading and intercourse and was an authority upon the use of the microscope in textiles. He had both speaking and reading knowledge of French, German and Spanish, and inheriting his father's musical abilities, he was a church organist and an excellent singer.

He was a believer in the "duties which a man owes to the town in which he lives," and took great interest in the First Unitarian Church, the Clinton Hospital, the Public Library and the National Bank and Savings Bank, in all of which he was an officer. He was a director in the Gibbs Loom Harness and Reed Co., a member of the Boston Textile Club, Athletic Club, Algonquin Club, Home Market Club and American Society of Mechanical Engineers.

His contributions to the Transactions of the Association were on the Measuring the Tension of Spindle Bands, Micrographs of Cotton, Mill Lighting, Power Tests on Gingham Looms, Sizing, Steam Heating of Mills, and also a report on the New Orleans Cotton Exposition. He was a director of this Association from 1883–1886.

He was offered membership as the representative of the United States to the Textile Congress held at Paris during the exposition of 1900, a position for which his experience as a cotton manufacturer and his knoweldge of the French language admirably qualified him, but he declined on the ground that his health at the time was not in an assured condition to take the journey. He had traveled extensively, visiting Europe about 12 times, and also the Orient as well as the whole of the United States, including Alaska.

He resigned from his position as agent in 1896, and spent the remainder of the time largely in travel. On his return from the Pacific coast, April 29, 1902, he was badly injured in a railroad accident at Como, Missouri, and was confined in a hospital there for about two months, but he never regained his health, and on Oct. 7, 1902 he dictated a letter to the secretary of this Association, and walked out with an attendant while the letter was being transcribed on the typewriter, but fell dead with heart disease, and the posthumous letter was transmitted without signiture with an explanatory note stating the reason.

His life was a prosperous one commercially as well as professionally, and in his will he bequeathed $1000 to this Assotion, of which he became a member April 20, 1870.

PAST MEMBERS OF THE ASSOCIATION.

The following list includes those who have been elected members of the Association since its organization April 20, 1865, but does not include any of the present members. Those who are believed not to be living are marked with * unless the date of death is stated.

HONORARY MEMBERS.

Name.	Date of Death.	Date of Election.	Memoirs, vol. pp.
Benj. F. Nourse	Apr. 7, 1893	Oct. 16, 1872	
Jones S. Davis	Feb. 1, 1901	Apr. 20, 1865	70—53
Moses Pierce	Aug. 18, 1900	Oct. 30, 1878	69—53

ACTIVE MEMBERS.

Name.	Date of Death.	Date of Election.	Memoirs, vol. pp.
E. O. Abbot		July 19, 1865	
Stephen I. Abbott		Apr. 21, 1869	
Phinehas Adams	July 23, 1883	Apr. 20, 1865	
Stephen L. Adams	Aug. 11, 1900	Apr. 24, 1895	69—52
Sylvanus Adams		Apr. 20, 1865	
Henry L. Aldrich, Jr.		Apr. 28, 1886	
B. Adelbert Alexander	Sept. 14, 1900	Apr. 27, 1898	70—51
Franklin Allen		Oct. 18, 1900	
Wm. Ames, of Peterboro		Apr. 28, 1880	
James S. Amory	June 8, 1884	Jan. 15, 1868	
William Amory	Dec. 8, 1888	Jan. 15, 1868	
William Amory, Jr.		Apr. 16, 1873	
C. W. Anderson		Oct. 31, 1883	
Edmund L. Anthony		Apr. 25, 1883	
John W. Arrington		Oct. 25, 1895	
Stephen B. Ashley		Oct. 29, 1890	
George Ashworth		Oct. 31, 1888	
Frank Atkin		Apr. 28, 1880	
George Atkinson		July 17, 1867	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
J. S. Atwood		July 19, 1865	
William A. Atwood	June 26, 1881	Apr. 20, 1870	
William C. Avery		Apr. 28, 1880	
D. M. Ayer		Apr. 20, 1865	
Eben Bacon		Jan. 15, 1868	
Benj. A. Bailey	Dec. 24, 1896	Apr. 25, 1877	
Charles Langdon Bailey	Dec. 28, 1900	Sept. 27, 1894	70—52
Joseph A. Baker		Oct. 31, 1877	
Philip S. Baker		Oct. 25, 1895	
John Balch		Apr. 20, 1865	
David Ballou		Apr. 27, 1881	
A. A. Barker		Apr. 30, 1879	
A. D. Barker		Apr. 19, 1871	
Cyrus I. Barker		Apr. 21, 1869	
William E. Barrows	July 30, 1901	Oct. 16, 1872	
Henry S. Bartlett		Apr. 25, 1883	
Joseph C. Bartlett		Apr. 16, 1873	
Lewis C. Bass		Oct. 28, 1891	
Samuel Batchelder		Apr. 25, 1877	
Stockton Bates		Oct. 27, 1875	
Charles F. Battles	Nov. 16, 1870	Apr. 21, 1869	
F. F. Battles	Sept. 19, 1889	Apr. 20, 1865	
George W. Bedlow	Aug. 7, 1883	Oct. 16, 1872	
T. R. Belcher		July 15, 1868	
George W. Belt		Oct. 25, 1893	
John A. Bennett		Apr. 20, 1865	
Thomas Bennett, Jr.	Apr. 18, 1898	Apr. 20, 1865	
Nathan Benton		Apr. 25, 1877	
John Birkenhead	Jan. 31, 1902	Apr. 25, 1877	
J. H. Blades		Apr. 27, 1898	
Samuel Blaisdell, Jr.		Oct. 25, 1876	
Ezekiel Blake		Jan. 15, 1868	
D. W. Bliven		Apr. 25, 1883	
S. B. Bond		Apr. 20, 1870	
Andrew Borden		Apr. 27, 1887	
Israel Borden	July 15, 1883	July 19, 1865	
Thomas S. Borden		Oct. 31, 1877	
James N. Bourne		Apr. 27, 1887	
Samuel C. Bowdoin	Aug. 23, 1894	Oct. 31, 1883	
H. C. Bowen		Apr. 19, 1871	
Erastus Boyden		July 15, 1868	
James G. Brackett		Apr. 26, 1876	
Edward S. Bradford		Oct. 30, 1878	
Joseph Brady	Sept. 27, 1895	Oct. 18, 1871	
B. C. Brainard		Apr. 15, 1874	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
J. E. Brann		Apr. 21, 1875	
David A. Brayton	Aug. 20, 1881	Apr. 21, 1869	
Thomas E. Brayton		Apr. 26, 1882	
A. Briggs		Apr. 20, 1865	
Lucius Briggs*		Jan. 15, 1868	
Edward A. Brigham		Apr. 25, 1877	
Walter D. Brigham		Apr. 24, 1895	
A. D. Brown		Apr. 20, 1865	
Alexander G. Brown		Oct. 27, 1880	
George S. Brown		Apr. 28, 1880	
H. H. Brown		Apr. 20, 1865	
Josiah Brown	July , 1875	July 17, 1867	
S. N. Brown		Oct. 29, 1890	
E. C. Bryant		Oct. 15, 1873	
George C. Buchanan		Apr. 27, 1881	
R. A. Budlong		July 19, 1865	
James W. Burke	Nov. 5, 1886	Oct. 27, 1875	
William Alvord Burke	May 28, 1887	Apr. 20, 1865	
George W. Burleigh	April 25, 1878	Apr. 20, 1865	
Micajah C. Burleigh	March 7, 1881	July 19, 1865	
A. B. Burleson		July 19, 1865	
Danforth Bushnell		Apr. 27, 1881	
Francis Cabot		Jan. 15, 1868	
Wm. D. Cadwell	Oct. 10, 1902	Apr. 19, 1871	
George Callaghan		Apr. 28, 1880	
Samuel R. Campbell		Apr. 28, 1886	
Thomas W. Canady		Apr. 15, 1874	
William B. Card		Jan. 15, 1868	
Arnold B. Chace		Oct. 27, 1875	
Arnold B. Chace, Jr.		Apr. 24, 1895	
John E. Chace		July 19, 1865	
Jonathan Chace		Oct. 20, 1869	
H. S. Chadwick	Mar. 2, 1899	Apr. 24, 1895	66—49
D. J. Champlin		July 19, 1865	
Alfred D. Chandler		Apr. 15, 1874	
Thomas C. Chandler		Oct. 27, 1880	
William H. Chandler		Oct. 27, 1875	
William C. Chapin	Jan. 7, 1902	July 19, 1865	
Bowers S. Chase		Oct. 27, 1875	
Chauncey C. Chase	Apr. 13, 1895	Apr. 26, 1893	59—35
Isaac B. Chase	Oct. 17, 1887	Oct. 18, 1871	
S. Angier Chase	Nov. 30, 1900	July 19, 1865	
J. Taylor Cheetham		Apr. 21, 1875	
George A. Clark		Oct. 25, 1882	
J. William Clark	Aug. 1900	Oct. 26, 1892	
Jeremiah Clark	Apr. 22, 1898	Apr. 15, 1874	64—46
John Clark		Oct. 31, 1883	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
Stephen Clark		Apr. 20, 1865	
Alfred Clarke		Apr. 30, 1879	
Frederick E. Clarke	Nov. 6, 1899	Apr. 20, 1865	67—50
Alonzo A. Coburn		Apr. 25, 1888	
Edward W. Codman		Oct. 31, 1877	
Francis Cogin		Apr. 25, 1877	
Daniel S. Collins		Apr. 16, 1873	
J. Andrew Comstock		Oct. 28, 1885	
J. P. Congdon		July 19, 1865	
D. E. Converse		Oct. 27, 1880	
Albert Cook		Oct. 15, 1873	
R. G. Cornell		Apr. 21, 1869	
David W. Cowen		Apr. 30, 1879	
Daniel Dane Crombie	Mar. 15, 1886	July 19, 1865	
Levi Cross		Apr. 17, 1872	
James W. Cumnock		Apr. 30, 1879	
John Cumnock		Apr. 16, 1872	
James M. Cunliff		Oct. 20, 1869	
A. Dahlgren		Oct. 31, 1883	
Theron J. Dale	Aug. 23, 1871	Jan. 15, 1868	
Horace Daniels*		Oct. 20, 1869	
Joshua W. Daniels		Oct. 21, 1868	
E. S. Davis	June 11, 1893	Apr. 21, 1869	
Henry A. Davis		Apr. 25, 1888	
James C. Davol		Apr. 25, 1877	
Stephen Davol	Mar. 7, 1888	July 19, 1865	
Wm. Davol, Jr.		Apr. 20, 1870	
B. W. Bean		Oct. 27, 1875	
James C. Deane		Apr. 25, 1894	
James Dempsey	Oct. 1, 1894	Apr. 15, 1874	57—30
William P. Derby		Oct. 29, 1879	
Frederic Dexter	Mar. 7, 1895	Oct. 27, 1875	
George Dexter		Oct. 31, 1877	
Lewis Dexter		Jan. 15, 1868	
Samuel Dibble		Sept. 29, 1898	
John Worthington Dickinson, Jr.	June 4, 1900	Oct. 28, 1897	71—53
Charles C. Diman	Nov. 7, 1897	Apr. 24. 1895	63—44
Albert J. Dorr		Oct. 21, 1874	
William Douglass		Oct. 26, 1892	
John G. Downes		Oct. 25, 1876	
George Draper	June 7, 1887	July 17, 1867	
Joseph Dronsfield		Nov. 30, 1881	
F. S. Brown		Oct. 27, 1880	
John Drowne	Jan. 27, 1900	Apr. 29, 1896	68—49
James A. Dupee	Oct. 18, 1886	Apr. 17, 1862	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
George B. Durfee		Apr. 26, 1876	
Walter C. Durfee	Dec. 8, 1901	Oct. 18, 1871	
Edmund Dwight	June 6, 1900	Apr. 17, 1872	
A. D. Eaton		Oct. 27, 1875	
Charles L. Eaton		Oct. 15, 1873	
Isaac Eaton		Apr. 25, 1877	
George H. Eddy		Apr. 16, 1873	
Ernest Edwards		Apr. 21, 1875	
Jacob Edwards		Oct. 30, 1878	
D. M. Ehrlich		Apr. 24, 1895	
John A. Emery		Oct. 18, 1871	
Charles Estes		Apr. 26, 1900	
George F. Fabyan		Apr. 25, 1877	
John R. Fales*		Apr. 20, 1870	
Alonzo Falls		Apr. 26, 1876	
C. E. Falls		Oct. 25, 1895	
John W. Farwell		Oct. 16, 1872	
N. W. Farwell	Sept. 7, 1886	Apr. 19, 1871	
Samuel Fay*		Apr. 20, 1865	
Henry S. Fenner		Apr. 26, 1876	
A. R. Field		Oct. 15, 1873	
Clifton L. Field		Apr. 25, 1894	
George W. Fisher		Oct. 31, 1877	
Albert W. Flack		Apr. 30, 1879	
George S. Follansbee		Apr. 15, 1874	
Franklin Forbes	Dec. 24, 1877	Apr. 20, 1865	
Henry A. Forbes		July 15, 1868	
Ira H. Foss	Sept. 29, 1889	Oct. 20, 1869	
J. Dwight Francis		Oct. 29, 1879	
Charles W. Freeland		Oct. 18, 1871	
Marshall French		July 15, 1868	
Frank H. Fries		Apr. 25, 1883	
George W. Frost		Apr. 20, 1865	
Melville Gambrill		Oct. 25, 1882	
William B. Gambrill		Apr. 25, 1883	
A. J. Gardiner		Apr. 21, 1869	
Richard Garsed	July 27, 1897	Apr. 17, 1872	63—43
John Gegenheimer		Apr. 30, 1890	
George K. Gibbs		Oct. 30, 1878	
James Gildard	June 10, 1902	July 17, 1867	
Daniel J. Gilligan	June 25, 1901	Apr. 29, 1896	71—54
John Gilligan		Sept. 29, 1898	
David Gillis		Apr. 20, 1865	
Clinton C. Gilmore		Apr. 20, 1870	
George C. Gilmore		Apr. 16, 1873	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
John H. Glover	Jan. 1870	July 19, 1865	
Charles J. Goodwin	May 27, 1898	Oct. 18, 1871	
George M. Goodwin		Apr. 25, 1877	
William James Goulding		Oct. 15, 1873	
William F. Goulding	1885	Oct. 16, 1872	
David Gowdey		Oct. 19, 1870	
William B. Gowdey		Apr. 30, 1890	
Archibald M. Graham		Apr. 25, 1883	
George H. Grant		Apr. 17, 1872	
George P. Grant	Aug. 8, 1896	Sept. 27, 1894	61—38
James Grant		Oct. 29, 1879	
William B. Gray	Jan. 27, 1894	Apr. 25, 1888	
Benjamin Greene*		July 19, 1865	
Gardiner Greene	Oct. 30, 1895	Jan. 15, 1868	
Stephen Greene	Nov. 7, 1901	Oct. 27, 1886	71—55
Wm. H. Greene	June 28, 1902	Apr. 25, 1901	73—
Frank R. Hadley	Apr. 23, 1897	Oct. 28, 1891	62—44
Effingham C. Haight	July 18, 1901	Apr. 27, 1899	71—54
Augustine Haines	July 27, 1873	July 19, 1865	
William P. Haines	July 2, 1879	July 19, 1865	
Samuel Hale		Apr. 29, 1891	
James M. Hall		Oct. 18, 1871	
H. P. Hammett	May 8, 1891	Apr. 25, 1877	
Russell Handy*		Oct. 29, 1879	
J. F. Hanson		Oct. 27, 1880	
Charles Hardy	Dec. 30, 1877	Oct. 15, 1873	
Frank L. Harmon		Oct. 16, 1872	
Charles M. Harris, Jr.	Nov. 10, 1892	Apr. 15, 1874	
Frank Harris		Apr. 24, 1889	
George B. Harris	May 2, 1890	Apr 26, 1876	
James M. Harvey		Oct. 29, 1879	
Frank Haskell	July 24, 1896	Apr. 25, 1883	61—37
James Haskell		Apr. 20, 1865	
Thomas Haskell		Apr. 25, 1877	
A. M. Hathaway		Sept. 27, 1894	
George T. Hathaway	July 20, 1891	Oct. 31, 1877	
Edward B. Hayden	Aug. 1898	July 19, 1865	
Horace L. Hayden		Apr. 24, 1895	
Jeffrey Hazard		Apr. 28, 1886	
Joseph Healy	Jan. 21, 1901	Apr. 16, 1873	
S. H. Hewett		Apr. 21, 1869	
Jefferson Higgins		Apr. 27, 1881	
John H. Higgins		July 19, 1865	
Charles L. Hildreth		Apr. 28, 1880	
E. B. Hill		Oct. 21, 1868	
George E. Hill		Oct. 25, 1876	

Name.	Date of Death.	Date of Election.	Memoirs vol. pp.
George T. Hill		July 19, 1865	
James Gilbert Hill	Apr. 4, 1901	Jan. 15, 1868	70—54
John Hill	Jan. 20, 1898	Oct. 25, 1876	
J. P. Hillard	Oct. 18, 1892	Apr. 17, 1872	
Albert H. Himes		July 15, 1868	
John H. Hines		Sept. 27, 1894	
Ernest S. Hobbs		Oct. 25, 1876	
Reuben M. Hobbs	Oct. 6, 1890	Apr. 26, 1876	
Samuel Hodgkins		Oct. 16, 1872	
John Holland	May 29, 1900	Apr. 24, 1878	69—51
Stephen Holman		Apr. 15, 1874	
George W. Holt		Jan. 15, 1868	
J. W. Holt		Apr. 20, 1865	
Francis B. Hood	Dec. 16, 1899	Oct. 21, 1874	
George L. Hooper		Apr. 26, 1893	
William Hooper		Apr. 27, 1887	
John Hopkinson		Apr. 25, 1883	
William T. Horrobin	Mar. 7, 1884	July 17, 1867	
Thomas Horsfield		Oct. 28, 1897	
Amos F. Howard		July 19, 1865	
Angelo Howard		Oct. 31, 1877	
Bion B. Howard	Dec. 17, 1881	July 19, 1865	
Edward Howe		Apr. 21, 1869	
Richard G. Howland, 2nd		Apr. 20, 1870	
John M. Hull*		Apr. 28, 1880	
Daniel Hussey	July 25, 1883	July 19, 1865	
Oliver P. Hussey	Jan. 2, 1875	July 17, 1867	
Herbert Ingraham		Oct. 27, 1875	
Patrick T. Jackson*		July 17, 1867	
Patrick T. Jackson, Jr.		Oct. 20, 1869	
Barton H. Jenks		Apr. 17, 1872	
Frank A. Jenks		Apr. 28, 1897	
Stephen A. Jenks		Oct. 30, 1878	
W. H. Jennings	June 13, 1885	Jan. 15, 1868	
William C. Jillson	Jan. 2, 1898	Apr. 15, 1874	
Daniel Webb Johnson	Apr. 29, 1894	Jan. 15, 1868	57—29
C. W. Johnston		Apr. 27, 1898	
D. J. Johnston	Oct. 12, 1894	July 17, 1867	57—31
Robert Johnston	Sept. 11, 1890	July 17, 1867	
George H. Jones		Jan. 15, 1868	
Russell L. Jones		Apr. 17, 1872	
George E. Jordan		Apr. 26, 1893	
Royal Kalloch		Apr. 25, 1877	
Thomas W. Kanada		Apr. 21, 1875	
Joseph H. Kendrick	Feb. 20, 1900	Apr. 30, 1879	68—50

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
L. E. Kent	Feb. 26, 1901	Oct. 15, 1873	
William J. Kent	Mar. 30, 1897	Oct. 27, 1887	62—41
Edward Kilburn		Apr. 20, 1865	
E. C. Kilburn	Dec. 29, 1884	Oct. 18, 1871	
William H. Kilvert		Apr. 21, 1875	
H. C. Kimball		Apr. 20, 1865	
John M. Kimball	Aug. 24, 1902	Oct. 31, 1888	
Benjamin B. Kirk		Apr. 28, 1897	
Richard Kitson	July 13, 1885	Apr. 20, 1870	
J. H. A. Klauder		Oct. 31, 1888	
Albert Knight	Feb. 9, 1902	Apr. 24, 1895	
C. Prescott Knight		Sept. 29, 1898	
Joseph F. Knowles		Oct. 25, 1882	
Edwin Lamson	Mar. 13, 1895	Oct. 30, 1878	
Ira F. Laury		Nov. 30, 1881	
Abbott F. Lawrence		Apr. 24, 1895	
Frederic A. Leigh	Aug. 16, 1890	Oct. 22, 1869	
Thomas J. Leiper		Oct. 27, 1880	
E. S. Lesley		Apr. 20, 1865	
Willard Levins		Oct. 19, 1870	
J. Ivers Lewis		Oct. 15, 1873	
G. F. Lincoln		Apr. 19, 1871	
William Lindsay	Feb. 26, 1897	Apr. 26, 1876	
Crawford E. Lindsey		Apr. 26, 1882	
Henry Lippitt	June 5, 1891	Oct. 27, 1875	
Thomas L. Livermore		Nov. 30, 1881	
Amos D. Lockwood	Jan. 16, 1884	July 19, 1865	
M. B. Lockwood		Jan. 15, 1868	
S. N. Lougee		Apr. 21, 1869	
Charles L. Lovering		Apr. 20, 1865	
Q. W. Lovering		Apr. 17, 1872	
Augustus Lowell	June 22, 1900	Oct. 25, 1876	
George M. Lowrie	June 25, 1895	Apr. 21, 1875	
Joseph S. Ludlam	Aug. 4, 1896	Apr. 21, 1875	61—37
Arthur T. Lyman		Jan. 15, 1868	
George W. Lyman	Sept. 24, 1880	Jan. 15, 1868	
William H. Magee		Oct. 31, 1883	
Albert T. Mansfield		Apr. 30, 1884	
Preston R. Mansfield		Oct. 18, 1871	
Edward E. Manton	Feb. 4, 1878	Apr. 26, 1876	
Thomas Marble	Oct. 13, 1890	Apr. 20, 1870	
Ira J. Martin		Oct. 26, 1892	
Rufus A. Maxfield	Nov. 21, 1896	Apr. 17, 1872	62—43
Richard McCarthy		Apr. 26, 1882	
W. E. McCoy		Apr. 27, 1880	
Charles McCreery	Aug. 9, 1893	Oct. 16, 1872	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
James E. McCreery		Apr. 16, 1873	
Joseph McCreery	Jan. 22, 1901	Apr. 17, 1872	
W. H. McDavitt		Apr. 27, 1887	
Chas. D. McDuffie	July 6, 1902	Apr. 21, 1869	73—
William E. McGill		Apr. 27, 1892	
James H. McMullan		Apr. 21, 1869	
William G. Means*		Jan. 15, 1868	
George A. Mebane		Apr. 27, 1898	
William Melcher		Apr. 20, 1865	
Timothy Merrick	Mar. 19, 1894	Apr. 21, 1869	58—33
Frank M. Messenger		Apr. 27, 1887	
Andrew Moody	, 1880	Apr. 21, 1869	
Joseph S. Moody		July 15, 1868	
J. Turner Morehead		Oct. 21, 1874	
George F. Morgan		Oct. 28, 1891	
George M. Morse		Apr. 17, 1872	
James A. Morse		Apr. 17, 1872	
Galen C. Moses		Oct. 16, 1872	
Fred S. Mosher		Oct. 25, 1895	
George Motley	Apr. 12, 1900	July 19, 1865	
Joseph A. Moyes	Mar. 7, 1896	Apr. 25, 1894	60—37
William B. Munroe	Mar. 30, 1899	Oct. 25, 1895	66—48
William H. Munroe		Apr. 24, 1878	
John Murphy		Apr. 28, 1880	
A. F. Nagle		Apr. 28, 1880	
C. M. T. Nealley		Oct. 27, 1875	
Charles S. Nelson		Oct. 27, 1880	
Ambrose J. Nichols		Apr. 30, 1884	
John Howard Nichols		Oct. 25, 1876	
Lafayette Nichols	Dec. 26, 1896	Oct. 18, 1871	
Charles Nourse	Mar. 1, 1886	July 19, 1865	40–54–61
Carlos Nudd		Oct. 18, 1871	
Eben H. Nutting		Apr. 25, 1883	
J. Clark Nutting		Apr. 27, 1881	
George H. Nye		Apr. 17, 1872	
John Oldfield		Apr. 30, 1884	
Warren M. Orswell	July 5, 1897	Apr. 16, 1873	64—45
James M. Osborn	May 13, 1898	Oct. 18, 1871	
Walter Paine, 3rd	Oct. 27, 1897	Apr. 20, 1865	
John C. Palfrey		July 19, 1865	
Daniel Park		Jan. 15, 1868	
Frank W. Parker		Apr. 25, 1894	
Theophilus Parsons		Apr. 25, 1877	
Robert E. Patterson		Oct. 25, 1876	
Charles S. Peach		Apr. 17, 1872	
J. A. Peirce		Oct. 15, 1873	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
J. R. Perry		Jan. 15, 1868	
William G. Perry		July 19, 1865	
John M. Pevey	Dec. 14, 1898	Oct. 27, 1875	
David Pheteplace		Oct. 28, 1885	
L. M. Pinkham		July 19, 1865	
J. K. Piper	Oct. 28, 1871	Oct. 20, 1869	
Thomas F. Plunkett		Oct. 27, 1880	
Walter Pollard		Oct. 30, 1889	
Thomas F. Porter		Apr. 20, 1865	
Thomas C. Powell		Oct. 30, 1889	
Gilbert W. Pratt		Oct. 30, 1878	
Thomas Pray, Jr.		Oct. 19, 1870	
A. M. Pulsifer		Oct. 27, 1875	
J. M. Pusey		Apr. 15, 1874	
James Renfrew	Sept. 28, 1900	Oct. 18, 1871	69—56
Roscoe C. Reynolds		Oct. 25, 1876	
John Rhodes	May 15, 1889	Jan. 15, 1868	
Charles P. Richardson	Aug. 1895	Apr. 20, 1865	
George Richardson	, 1879	Apr. 20, 1870	
C. T. Richmond		Apr. 28, 1897	
Howard Richmond		Apr. 25, 1883	
C. W. Rider		Apr. 29, 1896	
Andrew Robeson, Jr.		Oct. 21, 1868	
Louis Robeson		Apr. 25, 1888	
Richard D. Rogers*		Oct. 21, 1868	
W. S. Rogers		Oct. 15, 1873	
Charles E. Rogerson		Apr. 26, 1882	
Wanton Rouse	Feb. 8, 1883	Apr. 15, 1874	
Elliot Russell		Apr. 17, 1872	
J. H. Russell		Apr. 30, 1884	
William H. Salisbury	Feb. 19, 1902	Jan. 15, 1868	
William F. Salmon	Mar. 28, 1900	July 19, 1865	
Henry Saltonstall	Dec. 3, 1894	Jan. 15, 1868	58—34
William G. Saltonstall	July 21, 1889	Oct. 25, 1876	
Eugene H. Sampson	Aug. 28, 1891	Oct. 29, 1879	
F. O. Sands		Apr. 19, 1871	
John A. Sanford		Oct. 30, 1889	
A. H. Saunders		Jan. 15, 1868	
Benjamin Saunders		Apr. 20, 1865	
Charles Henry Savage		Apr. 26, 1893	
Henry B. Sawyer		Oct. 28, 1897	
Isaac R. Scott*		Apr. 20, 1865	
John Scott		Oct. 29, 1879	
George H. Searle		Apr. 26, 1876	
John C. Sharp, Jr.		Apr. 26, 1882	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
William E. Sharpless		Oct. 21, 1874	
E. M. Shaw		Apr. 17, 1872	
Joseph Shaw	Aug. 27, 1898	Apr. 26, 1882	
Thomas S. Shaw		July 15, 1868	
D. G. Sherman		Oct. 19, 1870	
E. G. Sherman		Apr. 17, 1872	
George E. Sherman		Apr. 27, 1881	
John D. Sherman		Oct. 21, 1874	
Charles O. Shove	July 28, 1875	Apr. 20, 1865	
George H. Simmons		Oct. 29, 1879	
James B. Siner		Oct. 21, 1874	
John P. Slade	June 12, 1902	Oct. 27, 1875	
Arba Covel Slater	Sept. 3, 1900	Jan. 15, 1868	69—54
Francis A. Small		Apr. 20, 1870	
D. B. Smith		July 19, 1865	
George H. Smith		Apr. 19, 1871	
John C. Smith		July 19, 1865	
Robert R. Smith	May 12, 1900	Oct. 19, 1870	68—52
Waterman Smith		Apr. 20, 1865	
William Smith		Oct. 15, 1873	
William O. Smith		Apr. 28, 1897	
Alden J. Snell		Apr. 20, 1865	
William T. Spear		Oct. 30, 1889	
S. S. Spencer	Nov. 12, 1901	Oct. 25, 1876	
William M. Spink		Apr. 21, 1869	
Daniel N. Spooner*		Jan. 15, 1868	
James C. Stanley		Apr. 25, 1877	
Robert L. Steele		Oct. 27, 1880	
B. T. Stephenson		Apr. 27, 1887	
Wilbur A. Stiles		Apr. 28, 1880	
J. M. Stone		Oct. 30, 1878	
Joseph Stone		Oct. 21, 1874	
Royal O. Storrs	May 27, 1888	Oct. 29, 1879	
S. E. Stott		Apr. 16, 1873	
Ezekiel Albert Straw	Oct. 23, 1882	Apr. 20, 1865	33—56
John B. Straw		Apr. 30, 1879	
Henry D. Sullivan	Aug. 29, 1889	Oct. 15, 1873	
Albert A. Sweet		Apr. 24, 1895	
Albert S. Sweet		Apr. 26, 1893	
Charles A. Sweet		Oct. 26, 1892	
Charles J. Sweet		July 15, 1868	
Edward P. Taft	Nov. 5, 1899	Oct. 28, 1885	67—49
Charles F. Tarbell*		Apr. 27, 1881	
George Taylor		Apr. 25, 1877	
Edwin R. Thomas		Apr. 17, 1872	

Name.	Date of Death.	Date of Election.	Memoirs. vol. pp.
George C. Phillips		Apr. 24, 1895	
H. T. Schaefer		Sept. 29, 1898	
J. Foster Searles		Apr. 26, 1900	
John E. Searles		Oct. 5, 1899	
E. A. Smith		Oct. 25, 1895	
Lewis R. Speare		Oct. 25, 1895	
C. T. Switzler		Apr. 26, 1900	
Winthrop Thayer	July 18, 1900	Apr. 29, 1896	69—51
G. A. Thudium	June 8, 1896	Apr. 24, 1895	61—39
George E. Tillinghast		Oct. 18, 1900	
Arthur J. Warren		Apr. 27, 1899	

PROCEEDINGS.

In accordance with the legal notice the stated semi-annual meeting of the Association was held at the hall of the American Society of Mechanical Engineers, No. 12 West Thirty-First St., New York, N. Y., on September 30-October 2, 1902.

The following 127 members and 105 guests were present:

HONORARY MEMBER.

GEORGE ARMS, New York, N. Y.

ACTIVE MEMBERS.

H. C. ATWOOD, Providence, R. I.
NATHANIEL F. AYER, Boston, Mass.
G. H. T. BABBITT, Chicopee Falls, Mass.
DICKERSON G. BAKER, Willimantic, Conn.
LOUIS B. BARKER, Central Falls, R. I.
EDWIN N. BARTLETT, North Oxford, Mass.
ROBERT BEATTY, Philadelphia, Pa.
A. C. BENT, Taunton, Mass.
FRANK A. BOWEN, Lowell, Mass.
ARTHUR F. BRACKETT, Riverpoint, R. I.
A. W. BRAINERD, Millville, N. J.
ERNEST BRIDGE, Jersey City, N. J.
ROBERT BURGESS, Pawtucket, R. I.
W. R. BURNHAM, Norwich, Conn.
JOHN A. COLLINS, Fall River, Mass.
B. B. COMER, Birmingham, Ala.
FRANK B. COMINS, Boston, Mass.

JOHN J. CONNELL, Lowell, Mass.
P. T. CREED, Taunton, Mass.
GEORGE DEFOREST, Utica, N. Y.
CHARLES W. DENNETT, North Adams, Mass.
EDWARD P. DENNIS, Lowell, Mass.
CHARLES A. DENNY, Leicester, Mass.
GEORGE OTIS DRAPER, Hopedale, Mass.
HARRY K. DREW, Woonsocket, R. I.
D. A. EVERLY, Pawtucket, R. I.
CHARLES F. FARRAR, Fall River, Mass.
CHARLES H. FISH, Dover, N. H.
M. F. FOSTER, Milford, N. H.
JOHN W. FRIES, Winston-Salem, N. C.
JAMES GEE, Fiskville, R. I.
DAVID GROVE, Central Falls, R. I.
ARTHUR H. GULLIVER, Waltham, Mass.
WILLIAM J. HADFIELD, Newburgh, N. Y.
A. G. HARRIS, Upper Troy, N. Y.
WILLIAM D. HARTSHORNE, Lawrence, Mass.
FRED HAWKESWORTH, Montreal, P. Q.
W. G. HENDERSON, Norwich, Conn.
JOSEPH B. JAMIESON, Boston, Mass.
FRANK E. KALEY, Milford, N. H.
ROLAND R. KELLY, Williamstown Sta., Mass.
FRED LACEY, Valleyfield, P. Q
J. COLBY LEWIS, Gainesville, Ga.
WILLIAM H. LOFTUS, Newark, N. J.
WILLIAM L. LYALL, Boston, Mass.
JAMES R. MACCOLL, Pawtucket, R. I.
ARTHUR B. MANN, New York, N. Y.
THOMAS MAYOR, Providence, R. I.
JOSEPH MERCER, Willimantic, Conn.
JOSEPH MERRIAM, Middletown, Conn.
R. M. MILLER, Jr., Charlotte, N. C.
J. R. MONTGOMERY, Windsor Locks, Conn.
JOSEPH H. POTTER, Jr., Fall River, Mass.
JOHN E. PREST, Cohoes, N. Y.
JOHN F. REARDON, Norwich, Conn.

JOHN K. RUSSELL, Philadelphia, Pa.
ARNOLD B. SANFORD, Boston, Mass.
PARDON B. SANFORD, Utica, N. Y.
ARNOLD SCHAER, Warren, R. I.
WILLIAM F. SHERMAN, Boston, Mass.
HERBERT H. SHUMWAY, Taunton, Mass.
ARTHUR T. SMITH, Langley, S. C.
J. C. SMITH, Fall River, Mass.
THOMAS HENRY SMITH, Jamestown, N. Y.
WILTON H. SPENCER, Providence, R. I.
LEROY SPRINGS, Lancaster, S. C.
WALTER F. STILES, Fitchburg, Mass.
WALTER H. SUMMERSBY, Lawrence, Mass.
GEORGE P. TAYLOR, Clinton, Mass.
JAMES W. TAYLOR, Taunton, Mass.
EDWARD W. THOMAS, Cooleemee, N. C.
JOSEPH WATTERS, Fall River, Mass.
W. B. SMITH WHALEY, Columbia, S. C.
EDWARD B. WILBUR, Newbury, S. C.
JOHN B. WILD, Utica, N. Y.
WILLIAM E. WINCHESTER, Philadelphia, Pa.
C. J. H. WOODBURY, Lynn, Mass.

ASSOCIATE MEMBERS.

EUGENE C. ANDRES, Boston, Mass.
GEORGE R. BABBITT, Providence, R. I.
D. C. BALL, New York, N. Y.
EDWIN BARNES, Boston, Mass.
ALBERT BIRCH, Somerville, Mass.
F. H. BISHOP, Boston, Mass.
EDMUND E. BLAKE, Newton Upper Falls, Mass.
J. FRANK BRAIDS, Providence, R. I.
HENRY GORDON BRINCKERHOFF, Boston, Mass.
JOHN H. BURGHARDT, Boston, Mass.
EUGENE E. BURNHAM, Lawrence, Mass.
HARRY W. BUTTERWORTH, Philadelphia, Pa.
JAMES BUTTERWORTH, Philadelphia, Pa.
MALCOLM CAMPBELL, Woonsocket, R. I.

MELVIN H. COFFIN, Whitinsville, Mass.
THOMAS G. COX, Taunton, Mass.
C. F. CURWEN, Salem, Mass.
E. W. DAVENPORT, Providence, R. I.
G. B. EMMONS, Lawrence, Mass.
T. C. ENTWISTLE, Lowell, Mass.
JOHN T. FYANS, Fall River, Mass.
RUFUS B. GOFF, Providence, R. I.
SAMUEL M. GREEN, Holyoke, Mass.
WALTER M. HASTINGS, Boston, Mass.
DAVID JACKSON, Pawtucket, R. I.
FRANK B. KENNEY, Lowell, Mass.
SANFORD E. LORING, Syracuse, N. Y.
CHARLES B. MOORE, Boston, Mass.
ROBERT W. NEFF, Boston, Mass.
WILLIAM R. NOONE, Boston, Mass.
WILLIAM F. PARISH, Jr., Boston, Mass.
ARTHUR PARKINSON, New York, N. Y.
CHARLES A. M. PRARAY, Providence, R. I.
E. R. RICHARDSON, Pawtucket, R. I.
DWIGHT SEABURY, Pawtucket, R. I.
H. E. STAFFORD, Readville, Mass.
JAMES STRANG, Indian Orchard, Mass.
GEORGE C. TEWKSBURY, Boston, Mass.
JAMES T. THORNTON, Providence, R. I.
A. CURTIS TINGLEY, Providence, R. I.
ALLISON W. TRAFFORD, Fall River, Mass.
ARTHUR TURNBULL, Providence, R. I.
CLEMENT A. WAKEFIELD, Biddeford, Me.
LETTICE R. WASHBURN, New Bedford, Mass.
ROBERT C. WEBSTER, Boston, Mass.
WILLIAM R. WEST, New Bedford, Mass.
W. W. WHITE, Worcester, Mass.
FRED A. WILDE, Pawtucket, R. I.
ERVING YALE WOOLLEY, Boston, Mass.

GUESTS.

O. P. AUSTIN, Treasury Department, Washington, D. C.
W. R. BAILEY, 166 Duane St., New York, N. Y.
G. W. BAILY, 61 Cotton Exchange, New York, N. Y.
S. W. BALDWIN, 71 Broadway, New York, N. Y.
SUMNER BALLARD, 18 Beaver St., New York, N. Y.
W. W. BALLAUGH, 377 Broadway, New York, N. Y.
H. O. BARNES, 377 Broadway, New York, N. Y.
H. W. BIBLE, Wool Exchange, New York, N. Y
G. W. BISHOP, Passaic, N. J.
W. T. BONNER, 53 State St., Boston, Mass.
CHARLES O. BOYD, 27 State St., Boston, Mass.
J. H. BRAGDON, 377 Broadway, New York, N. Y.
WILLIAM J. BRIGGS, 166 Duane St., New York, N. Y.
F. F. BURGIN, 396 Broadway, New York, N. Y.
FRANK H. BURT, 1046 Tremont Building, Boston, Mass.
A. C. BUTLER, 35-36 Mason Building, Boston, Mass.
HARRY D. CARTER, Lancaster Mills, Clinton, Mass.
ALBERT A. CARY, 95 Liberty St., New York, N. Y.
JOHN CHERRIE, 290 Broadway, New York, N. Y.
W. W. CHRISTIE, Paterson Bank Building, Paterson, N. J.
WALTER H. CLAYTON, 31 Nassau St., New York, N. Y.
JOHN A. COLLINS, Jr., Arlington Mills, Lawrence, Mass.
J. A. COOPER, Whitin Machine Works, Whitinsville, Mass.
GEORGE T. COPPINS, Walworth Mfg. Co., Boston, Mass.
W. P. COTHARIN, 170 Summer St., Boston, Mass.
T. R. CROPPER, Jersey City, N. J.
ROGERS D. DAVIS, Lowell Machine Shop, Lowell, Mass.
B. H. DILLON, Charlotte, N. C.
S. H. DITCHETT, 200 Greene St., New York, N. Y.
JAMES M. DODGE, Nicetown, Philadelphia, Pa.
C. E. DUFFY, 2020 State St., Chicago, Ill.
L. C. FARNSWORTH, American Card Clothing Co., Providence, R. I.
G. C. FIELD, 170 Halsey St., Brooklyn, N. Y.
L. L. FLEMING, 25 Broad St., New York, N. Y.
P. J. FORBES, DeHaven Mfg. Co., New York, N. Y.
F. J. FREY, 43 Leonard St., New York, N. Y.
W. GAMBRILL, Wilmington, Del.

JOSEPH GOTT, Jr., 138 Bloomfield Ave., Newark, N. J.
C. B. GRAY, New York, N. Y.
H. D. GUE, 120 Liberty St., New York, N. Y.
J. T. GWATHMEY, 49 Cotton Exchange, New York, N. Y.
H. HAGEDORN, Room 20, Cotton Exchange, New York, N. Y.
FRANK HART, 25 Broad St., New York, N. Y.
H. C. HILL, Dover, N. H.
T. B. HITCHCOCK, Trement and Suffolk Mills, Lowell, Mass.
C. W. HOUSE, Jr., 86 Reade St., New York, N. Y.
SAMUEL T. HUBBARD, 510 Coffee Exchange, New York, N. Y.
ERNEST S. JAROS, 150 Nassau St., New York, N. Y.
C. J. JONES, 160 West Lehigh Ave., Philadelphia, Pa.
J. B. JONES, 240-250 West Somerset St., Philadelphia, Pa.
RICHARD JOHNSON, English Card Clothing Co., Oldham. England.
JOSEPH C. KING, 68 Essex St., Boston, Mass.
W. L. KINKEAD, Paterson, N. J.
W. LOWENTHAL, Albany, N. Y.
J. J. MACCORMICK, 277 Broadway, New York, N. Y.
W. C. MAIN, Lawrence, Mass.
MALCOLM C. MAINE, 43 Cotton Exchange, New York, N. Y.
T. C. MARTIN, 114 Liberty St., N. Y.
JAMES F. MAURY, 79 Cotton Exchange, New York, N. Y.
R. P. MCDOUGALL, 14 Cotton Exchange, New York, N. Y.
E. L. MERROW, National Ring Traveler Co., Providence, R. I.
M. A. METCALF, 95 South St., Boston, Mass.
F. W. MILLER, 43 West 99th St., New York, N. Y.
WALTER T. MILLER, 29 Cotton Exchange, New York, N. Y.
N. A. MOYER, Southern Railway, Boston, Mass.
FRANK G. NORTH, Atlanta, Ga.
S. N. D. NORTH, 683 Atlantic Ave, Boston, Mass.
G. NICHOLSON, 40 Thomas St., New York, N. Y.
JAMES B. ORMEROD, Castleton, Manchester, England.
C. H. PARKER, 101 Milk St., Boston, Mass.
M. J. PARROTT, 6 Cotton Exchange, New York, N. Y.
EUGENE PEIRCE, 200 Greene St., New York, N. Y.
J. S. PHELPS, 78 West 103rd St., New York, N. Y.
H. F. J. PORTER, 100 Broadway, New York, N. Y.
ALFRED POTASKEY, 145 Greene St., New York, N. Y.

J. G. F. RANDOLPH, 131 Devonshire St., Boston, Mass.
WILLIAM RAY, 43, Cotton Exchange, New York, N. Y.
M. V. RICHARDS, Southern Railway, Washington, D. C.
A. C. ROWSEY, New York, N. Y.
W. D. SAWYER, 7 Wall St., New York, N. Y.
B. R. SMITH, Cotton Exchange, New York, N. Y.
J. L. STICKNEY, New York, N. Y.
CHARLES STILLMAN, 22 William St., New York, N. Y.
W. I. STIMPSON, Hopedale, Mass.
JOHN SUMNER, 30 Gilbert St., Boston, Mass.
G. R. SUTHERLAND, 49 Wall St., New York, N. Y.
JOHN TANNER, 8 Cotton Exchange, New York, N. Y.
J. THOMPSON, 40 Thomas St., New York, N. Y.
HERBERT GRAY TORREY, 30 Wall St., New York, N. Y.
ALBERT H. TYLER, 123 Liberty St., New York, N. Y.
E. N. VOSE, Dun's Review, New York, N. Y.
E. P. WALKER, 82 Wall St., New York, N. Y.
JOHN A. WALKER, 281 Congress St., New York, N. Y.
A. S. WATTLES, Canton Junction, Mass.
J. W. WATTLES, Canton Junction, Mass.
O. E. WOOLSON, Havemeyer Building, New York, N. Y.
Mrs. L. E. BARNES, Lawrence, Mass.
Mrs. H. G. BRINCKERHOFF, Boston, Mass.
Mrs. ELDRIDGE, New Bedford, Mass.
Mrs. T. C. ENTWISTLE, Lowell, Mass.
Miss JACKSON, Pawtucket, R. I.
Miss ISABEL THORNTON, New York, N. Y.
Mrs. J. P. THORNTON, Providence, R. I.
Mrs. HERBERT GRAY TORREY, New York, N. Y.
Mrs. F. A. WILDE, Pawtucket, R. I.

FIRST SESSION.

TUESDAY EVENING, SEPTEMBER 30, 1902.

The Association met in the hall of The American Society of Mechanical Engineers, 12 West Thirty-First Street, New York, at 8.15 P. M., President FISH in the chair.

The PRESIDENT. You will please come to order, gentlemen. The Secretary will read the call for the meeting.

The Secretary read the call for the meeting as follows:

BOSTON, MASS., September 1, 1902.

To the Members:

Notice is hereby given that the stated Semi-Annual Meeting of this Association will be held at New York City, Tuesday, Wednesday and Thursday, September 30 to October 2, 1902.

The sessions will be held in the hall of the American Society of Mechanical Engineers, 12 West Thirty-First Street. The first session will be held at 8.15 P. M., Tuesday, September 30. The second and third sessions will be held at 9.30 A. M. and 8.15 P. M. on Wednesday, Ootober 1, and the fourth and fifth at 9.30 A. M. and 2.30 P. M. on Thursday, October 2.

By Order of Board of Government,

C. J. H. WOODBURY,

Secretary.

The American Society of Mechanical Engineers, 12 West Thirty-First Street, on the south side of the street between Fifth Avenue and Broadway, have hospitably tendered the use of their building to the Association.

The first session will be called to order at 8.15 P. M. on Tuesday, September 30, at which welcome will be extended to the Association on behalf of the American Society of Mechanical Engineers.

It is expected that this session will be largely devoted to considerations of cotton as presented by Mr. J. Temple Gwathmey, President, and members of the New York Cotton Exchange. At the close of this session refreshments will be served in the banquet hall of the building.

The sessions on Wednesday will be called to order at 9.30 A. M. and 8.15 P. M., leaving the afternoon free for the members to visit points of interest and of recreation while in the city. The sessions on Thursday will be called to order at 9.30 A. M. and 2.30 P. M., adjourning in time for the members to leave New York by late afternoon trains. Lunch will be served to the members in the banquet hall during the noon recess, Thursday.

The details of the programme will not be issued until the meeting, and it is hoped that members will fully discuss papers presented, and for that purpose the secretary will mail to any member, if requested on the enclosed postal card, a few days before the meeting, copies of any papers which are desired for the purpose of preparing for the discussion, if such papers are in print.

It is desirable that each member should co-operate with the Board of Government in the plans for the meeting, by replying on the enclosed postal card whether they expect to attend or not, as it will enable suitable provisions to be made.

Papers are expected on the following subjects:

Our Foreign Commerce in Cotton Goods.
The Export of Cotton Goods.
The World's Supply and Consumption of Cotton.
Cotton Mill Expansion.
The Management of Mills.
Bleaching and Finishing of Textile Fabrics.
The Testing of Cotton Yarns.
Lubrication of Textile Mills.
Mill Construction on the Continuous Skeleton System.
The Under-Feed Stoker.

Tension on Roving Frames.
The Damagibility of Cotton Bales by Fire.
Preparation of Cotton for Carding and Spinning, Especially Egyptian Cotton.
The Card System in Mill Supply Accounts.
Observations on Spindle Banding.

It has not been feasible to arrange for special trains to New York, and hotel headquarters. It is expected that many visitors will be in New York at this time, and it is recommended that members who intend to attend the meeting will engage rooms in advance.

The following are the principal hotels in the vicinity:

Albemarle, Fifth avenue and 24th street.
Earlington, 55 West 27th street.
Fifth Avenue, Fifth avenue and 23rd street.
Gilsey House, Broadway and 29th street.
Grand, Broadway and 31st street.
Grand Union, Park avenue and 42d street.
Herald Square, 116 West 34th street.
Hoffman House, Broadway and 25th street.
Holland House, Fifth avenue and 30th street.
Imperial, Broadway and 32d street.
Manhattan, 42d street and Madison avenue.
Murray Hill, Park avenue and 40th street.
Normandie, Broadway and 38th street.
St. Cloud, Broadway and 42d street.
Sturtevant House, 1186 Broadway.
Victoria, 1146 Broadway.
Waldorf-Astoria, Fifth avenue, 33rd and 34th streets.

The Trunk Line Association will give to members and their guests, including ladies, provided one hundred Trunk Line certificates are presented, attending the meeting, round trip transportation for one and one-third fares, if over 75 cents, in accordance with the following conditions, from which they will make no deviation: On purchasing a ticket for New York procure a Trunk Line certificate from the station agent (but not a receipt). It is well for those who will come from local stations to make inquiry a few days in advance, in order to be sure that the ticket agent will have the certificate.

The ticket to New York is not good earlier than September 26, or

later than October 2, and returning, one can leave New York by the same route at any date before October 6.

On reaching the meeting give your certificates to C. J. H. Woodbury, Secretary, who will certify to the presence of the party and hand them to the representative of the Trunk Line Association, who will be present on Wednesday and Thursday, and will place on the certificate the endorsement of the Tariff Association. These endorsed certificates will enable persons on presentation at a railroad ticket office to obtain return tickets over the same route at one-third the regular fare. The agent of the Trunk Line Association at the hall must be paid a fee of 25 cents by the person procuring the ticket. The secretary of the Cotton Manufacturers' Association is not permitted under this agreement to sign any certificates after five o'clock, Thursday, October 2.

The attention of members is called to the list of former members of the Association which was distributed in proof last April, and it is hoped that the Association will be furnished with information of the dates of death of any former members in that list. This list does not contain the names of any present members of the Association.

The Board of Government have given instructions that there shall not be any exhibits of devices or the distribution of circulars in connection with the meeting.

The souvenir badges will be given to those members who are in attendance, and the Board of Government have given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

A blank proposition for membership is enclosed for convenience in submitting the names of any who would be desirable members. Many persons have not become members because they have not been invited.

Candidates for membership will be entitled to the privileges of the trip. Blank propositions are also inside the front cover of the Transactions, or will be sent on application.

Members who have overlooked their postal card receipts for transactions are requested to give the matter attention, as it is only through this means that the headquarters of the Association are able to know that members receive the volumes and notices to which they are entitled.

It is important that the Association should be promptly informed of changes of address of any members.

The SECRETARY. I certify that a copy of this call has been mailed to each member of the Association at least ten days in

advance of the date of this meeting, in accordance with Article 14 of the by-laws, and that a quorum is now present.

The records of the last meeting were read by the Secretary and approved.

PROGRAMME.

First Session, Tuesday, September 30, 1902, at 8.15 P. M.

Call to Order.

President's Address.

CHARLES H. FISH, Dover, N. H.

Welcome to the Association.

JAMES M. DODGE, Nicetown, Philadelphia, Vice-President of the American Society of Mechanical Engineers.

Greeting of the New York Cotton Exchange.

J. TEMPLE GWATHMEY, President.

Remarks are also expected from,

Messrs. SAMUEL T. HUBBARD,
JAMES F. MAURY,
WALTER T. MILLER,
L. L. FLEMING,

On behalf of the Committee of the New York Cotton Exchange appointed to meet the Association.

Refreshments will be served in the lower hall at 9.15 P. M.

Second Session, Wednesday, October 1, 1902, at 9.30 A. M.

Lubrication of Textile Mills.

WILLIAM F. PARISH, Jr., Boston, Mass.

Observations on Spindle Banding.

WILLIAM D. HARTSHORNE, Lawrence, Mass.

The World's Supply and Consumption of Cotton.

S. N. D. NORTH, Chief Statistician, Division of Manufactures, United States Census, Boston, Mass.

Preparation of Cotton for Carding and Spinning, Especially Egyptian Cotton.

JOHN J. CONNELL, Lowell, Mass.

The New York Cotton Exchange offers to members of the New England Cotton Manufacturers' Association the courtesies of the floor during the meeting. The door-keepers will admit on presentation of badges.

It is expected that the members will accept this invitation between 1 and 3 o'clock, P. M., on Wednesday.

The Cotton Exchange Building is on Hanover Square, and is conveniently reached by the Third Avenue Elevated to the Hanover Square Station. The entrance to the New York Cotton Exchange Building is on the west side of the station and take elevator to the Exchange floor.

Third Session, Wednesday, October 1, 1902, at 8.15 P. M.

Our Foreign Commerce in Cotton Goods.

O. P. AUSTIN, Chief, Bureau of Statistics, Treasury Department, Washington, D. C.

Mill Construction on the Continuous Skeleton System.

SANFORD E. LORING, Syracuse, N. Y.

Bleaching and Finishing of Textile Fabrics.

ARTHUR C. FREEMAN, New York City.

The Card System in Mill Supply Accounts.

FRANK P. VOGL, Claremont, N. H.

Fourth Session, Thursday, October 2, 1902, at 9.30 A. M.

Tension on Roving Frames.

WILLIAM E. WINCHESTER, Philadelphia, Pa.

The Under-Feed Stoker.

GEORGE C. TEWKSBURY, Boston, Mass.

The Testing of Cotton Yarns.

GEORGE R. SMITH, Bradford, England.

The Management of Mills.

CHARLES W. DENNETT, North Adams, Mass.

Lunch will be served in the lower hall at 1 P. M.

Fifth Session, Thursday, October 2, 1902, at 2.30 P. M.

Election of Members.

The Export of Cotton Goods.

WILLIAM P. WILSON, Sc.D., Director Philadelphia Commercial Museum, Philadelphia, Pa.

Cotton Mill Expansion.

ARNOLD B. SANFORD, Boston, Mass.

Report of Committee on Fire Test of Cotton Bales.

EDWARD W. THOMAS, Cooleemee, N. C.

WILLIAM D. HARTSHORNE, Lawrence, Mass.

On arrival at the hall, members and guests will please give their Trunk Line Certificates to C. J. H. WOODBURY, Secretary, who will certify to the presence of the party and hand them to the representative of the Trunk Line Association, who will be present on Wednesday and Thursday, and will place on the certificate the endorsement of the Association. They may be obtained from the representative of the Trunk Line Association in the front office on payment of a fee of 25 cents. These endorsed certificates will enable persons on presentation at a railroad ticket office to obtain return tickets over the same route at one-third the regular fare before October 6. The Secretary of the Cotton Manufacturers' Association is not authorized under this agreement to sign any certificates after five o'clock, Thursday, October 2.

The Board of Government have given instructions that there shall not be any exhibits of devices or the distribution of circulars in connection with the meeting.

Association badges will be given on registration to members in attendance, and the Board of Government have given instructions that duplicates shall not be distributed until after the adjournment, but other souvenir badges will be given to the guests of members.

PRESIDENT'S ADDRESS.

CHARLES H. FISH, Dover, N. H.

Gentlemen of the New England Cotton Manufacturers' Association : For the first time in the history of this Association, we meet, in convention, in this, the greatest and most important city of our country, the one city wherewith each and every company, corporation or private individual here represented, has direct business connections or affiliations, and within whose boundaries is daily transacted by far the greater part of the important business affairs governing in a large degree the transactions, not to say the welfare, of the cotton manufacturers of America.

It seems not only eminently fitting then that we should at last have chosen this location for our meeting, but also that we should find here, as we do, a welcome from the great organization, The New York Cotton Exchange, which is so important a factor in the question pertaining to our raw material and which is responsible to such an extent for the joys or sorrows of the annual make-up.

Beyond this, it is a distinguished honor to be permitted to assemble as the guests of the great American Society of Mechanical Engineers, in acceptance of its hospitable invitation to hold our Seventy-third Meeting in this building.

Every cotton manufacturer, no matter whether his knowledge has come to him through theoretical channels or through the hard knocks of a personal experience, or by both, he is, at least in a way, an engineer, although he may not have assumed the title of the honorable profession. A cotton manufacturer must

be responsible for engineering work in various degrees, from making the detail design and managing the construction, to the approval of the plans of others, for which he generally furnishes the inspiration. He must supervise the development of water powers, the building of dams, the installation of prime movers, whether by water or steam, the erection and equipment of mills, oftentimes in locations where the foundations require the exercise of the highest degree of skill, the organization of textile machine plants, the transmission of power, whether by belts or electricity, the erection of works for lighting, both by gas and electricity, and furthermore, conduct operations and attend to the maintenance of these numerous varieties of mechanisms, and provide against the depreciation by wear and tear and the greater losses due to subsequent invention.

To properly attend to these various duties may be unequal to the thoroughness expected of a specialist, but I maintain that it does constitute an engineer. But this is not merely an expression of individual opinion, for many years ago when the American Society of Mechanical Engineers received the proposition for membership of an agent of a cotton mill, the Council of that organization made an exhaustive investigation into the duties of the manager of a cotton mill and fixed the precedent, which resulted in the election to membership of many who are also members of the New England Cotton Manufacturers' Association, and several of these have been further honored by election as officers of the American Society of Mechanical Engineers.

If ever a man understood the dynamics of liquids and reduced his knowledge to practical application, it was the late HENRY R. WORTHINGTON, whose portrait graces these walls. In reply to the question as to whether he called himself a mechanical or civil engineer, Mr. WORTHINGTON stated that it was his ambition to be called a Pump Builder.

We are beginning to realize that engineering is one of the most important foundation stones of our success, and we should receive inspiration from our surroundings, from this auditorium, within whose walls have been heard the voices of the most able

engineers, the most astute mechanicians and the most successful business gentlemen the world has ever produced.

Briefly, I would call your attention to one or two matters of interest, which I believe deserve your consideration before this convention closes.

This Association was organized thirty-seven years ago, as the successor of a small local society of manufacturers, because the conditions required a larger field, and when it was incorporated in 1894, it availed itself of the opportunity of re-phrasing its constitution and by-laws and broadened its scope to meet the conditions as they have existed since that time, and it is now believed that the purpose of this organization would be better set forth, if, in place of the old title, dear to us all but which indicates a limitation that does not exist in this organization, a new name is adopted, and at this meeting a notice will be given of an amendment to be offered at the Spring Meeting, changing the title from the NEW ENGLAND to the AMERICAN.

I firmly believe that the time has come when we should, without departing from the present policy of the organization as stated in the constitution and by-laws and while maintaining the old standard, take for our Association a new name, indicating the universal or the national character of our work and our interest, removing the limitations which our present name suggests.

I would refer to another matter, which seems to me to be of interest and importance. At previous meetings of the Association, numerous and valuable papers have been submitted upon important questions pertaining to the various methods of ascertaining the cost of manufacturing. These have all been valuable contributions, but there is a collateral phase of the subject which deserves further and more serious consideration. I would suggest that this Association, following the precedent of other technical and commercial organizations, where valuable contributions have been made as to the unification of the methods of keeping accounts, should consider at this meeting the importance of

appointing a committee to present at some future meeting, a report upon a standard method of keeping our mill accounts.

I would call your attention to the badge which you wear at this convention, upon which is represented in miniature a bale of cotton. You will observe that the design is taken from the ordinary bale, or what is known as the Commercial Cotton Bale. This might be considered as bringing before us again the interesting and important question of the baling of cotton. As you know, this Association, in carrying out one of its fundamental principles, has from the first been keenly alive to everything pertaining to the essential questions of improving the condition of the cotton as delivered to the mill. These questions have included the presentations of matters pertaining to the betterment of the cotton fibre by cultivation and hybridization, as well as improvements in the care of ginning, baling and transportation. By invitation of the Board of Government, there has been presented at previous meetings, several papers, treating exclusively upon the baling of cotton by new methods. Whatever may be the merits of these radical departures in baling cotton, it is to be noted that the commercial bale is substantially the form as invented by Judge SIMON GRATZ of Missouri about a century ago; while cotton was covered with bagging in Kentucky by NATHAN BURROUGHS, in 1796, and this is still practically the only one in which the cotton is officially quoted on the market or delivered to the mills today.

It may be of interest in this connection, to state that an investigation in some old bill of lading books has shown that previous to 1817 cotton averaged 225 pounds per package, and after that the average weight increased to 298 pounds, while the average of the commercial bale of today is about 500 pounds.

Some old records in New York City indicate that the first mention of the export of cotton from this country occurred in 1739, when a sample was sent to England by a planter from Georgia, and in 1747 several bags of cotton valued at 3 pounds, 11 shillings, 5 pence, sterling, were exported from Charleston, S. C., and ten years later Liverpool records mention the arrival

of cotton from Charleston, S. C., and in 1770 three bales of cotton were shipped to Liverpool from New York, ten bales from Charleston, and four bales from Virginia and Maryland, and also three barrels from North Carolina.

In 1793 bales of cotton are referred to, and it was during this year that the application of the Whitney Cotton Gin initiated the commercial development of cotton, as an article of extensive commerce.

Again in this connection, I would state that during the past year the Board of Government, deviating from its usual practice, appointed a committee of two members, to attend a fire test of cotton bales, under the auspices of the National Fire Protection Association, and we expect that the report of this committee will be submitted at this meeting. This report will be interesting as bearing upon this subject of the damageability of cotton by fire under the various methods of packing in comparison with the commercial cotton bale.

It is not my intention to take up the time in unnecessary review or suggestions. The matters pertaining to the Association are, I believe, well in hand, and I am pleased to report a satisfactory increase in membership and a marked improvement in the interest shown in the Association and its work.

I wish to extend to you, gentlemen of the Association and guests, a warm welcome to this the seventy-third convention, and I sincerely trust that the proceedings at the sessions will prove interesting, aside from giving valuable information, and I hope also that you may all find sufficient time to avail yourselves of the many recreations which this location affords. I am sure you will pardon me for calling your attention to the fact that we are here primarily for business, if at the same time I impress upon you the importance of enjoying yourselves as you have the opportunity, and as I have no doubt you all deserve.

The PRESIDENT. Gentlemen, occupying a most prominent position among the technical societies of the world is our host, The American Society of Mechanical Engineers. We regret very much that the President could not be here this evening, but I understand that he has at this time a great deal to do and it was impossible for him to be present. I am very glad to say, however, that one of the most important officers of The American Society of Mechanical Engineers just at this time has very little to do — I will say by way of explanation that this gentleman's business is largely taken up in the handling of coal [Laughter] — so he has very kindly consented to come here this evening, and I now take great pleasure in introducing to you Mr. JAMES M. DODGE, Vice-President of The American Society of Mechanical Engineers. [Applause.]

Mr. JAMES M. DODGE. Mr. President, and members of the New England Cotton Manufacturers' Association and their guests, I might suggest that Mr. FISH might have called me also (?) as my business is handling coal. I will call your attention also to the fact that Mr. FISH'S speech is in this paper (holding up pamphlet copy of the President's address), and you will find the pith of my remarks on the two pages following, (indicating the blank leaves at the end of the address). [Laughter.]

In extending to your Association the cordial welcome of The American Society of Mechanical Engineers I very naturally felt when I received a suggestion from Mr. WOODBURY, your Secretary, that I perform this function, that it would be necessary for me to be quite elaborate. But I opened a copy of *Life* accidentally a day or two afterwards and I changed my mind. I found there the story of a young man down South who was an occasional correspondent of a New York paper. One day he got hold of a good story and telegraphed to the editor in New York: "Good story, twelve hundred words. Shall I wire?" The answer came back: "Make it six, go ahead." Another dispatch from the correspondent: "Can't be told in

less than twelve hundred. What shall I do?" Answer: "Creation of the World told in less than six hundred; try it." [Laughter.] So I thought I would get along without making a very long address or very elaborate remarks.

Then some of my relatives and friends came to my rescue and they suggested that it was a difficult task for a mechanical engineer, so they offered to help me out by writing some poems — epics, I might call them — and I will give you a specimen or two of them. I might elaborate before and I might make a few remarks after, but I think I will give them to you without comment.

Since the days of the old Pilgrim Father,
New England has learned something, rather;
All wool and yard wide
Has had its day and died,
And tonight we're for old Cotton Mather.

[Laughter.]

Then there is another one — it was a relative who sent me this:

There once was a monarch who sot on
His throne, and cried, "What have I got on?
I've a ten acre seat
And a realm at my feet;
Good gracious! I must be King Cotton?"
So they cried through the Nation
Without hesitation,
And what do you think?
They all took to drink,
With a three-times-three cheer,—
No rum and no beer,
Nor Croton or Vichy,
No, these were too fishy,
And the first smacked of sin,
So they all drank with joy of pure old cotton gin.

In extending to you a welcome of the Society of Mechanical Engineers I want to extend not a scale drawing welcome, but a

full sized, freehand drawing welcome that is not mechanical. It is good, it comes from the heart, and we are glad to have you all with us.

Before you go I might call the attention of those who are not familiar with this room to one or two things in it that are of interest. This is the portrait of ROBERT FULTON, painted by himself. I believe it is the only one extant painted by him. On the other side of the hall is a portrait of Captain ERICSSON and a model of the original Monitor beneath it. Back of you is the original drawing of the Fulton, the one that was used in constructing the vessel.

We trust you will enjoy yourselves here and we feel highly gratified to have the honor of your presence in our rooms. [Applause.]

The PRESIDENT. Gentlemen of the Association, we are users of cotton; we are all finishers, to be sure, in some way or other, but unfortunately we are not beginners. We can use the cotton, card it and spin it and weave it; but there is something done to it before we get it. We cannot find this cotton, we cannot pick it up; we have to buy it. No matter whether the price is high or the price is low, we have to pay it in order to obtain it and run chances at the other end. Sometimes it seems too bad that we cannot turn around and sell some of our products to the members of the New York Cotton Exchange and in that way get square with them. [Laughter.] Gentlemen, the members of the New York Cotton Exchange who are with us tonight are indeed very welcome. We are brother subjects of King Cotton of whom Mr. DODGE has just spoken, and I take very great pleasure in introducing to you now Mr. J. TEMPLE GWATHMEY, President of the New York Cotton Exchange. [Applause.]

Mr. J. TEMPLE GWATHMEY. Mr. President and gentlemen, the New England Cotton Manufacturers' Association was founded in April, 1865, and six years later, in April, 1871, the New York Cotton Exchange was created a body corporate; but not

until April of this year has there ever been any official recognition or communication between the two bodies, whose interests are so much the same. To your Secretary, Mr. C. J. H. WOODBURY, must be given the credit for having first suggested your asking our President of last year, Mr. HUBBARD, to speak to you at your meeting in the Spring at Boston; and to Mr. HUBBARD must be given the credit for the present interest that the officers of both of our organizations manifest in what I may term getting together; for he suggested to us that this could be done in only one way, and that was through personal intercourse. That we have believed him to be right is proven by our meeting with you here this evening, and, in order that you may see how very much we believe in this personal intercourse, I take pleasure, gentlemen, in saying to you that while you are in New York in convention the New York Cotton Exchange extends to you a cordial invitation to visit the Exchange at any time and also grants to you the privileges of the floor.

To bring us into even closer relations the officers of your Association are to meet the officers of our Exchange at dinner on Thursday evening, so that we may further discuss questions of mutual interest and listen to suggestions as to the advisability of the adoption of measures which may prove equally satisfactory and beneficial.

Your circular states that I and other members of the Exchange will speak on cotton. This is partially correct. The other members will discuss this subject before you and I shall be interested and instructed by them, as I trust you will also.

Before they are introduced to you, however, I wish to say for our Exchange, that we are very pleased that you have selected New York as your meeting place on this occasion, and trust that this, our first, meeting may be only the forerunner of many others which — when we begin better to understand each other — our mutual interests may demand. [Applause.]

The PRESIDENT. Perhaps it would not be out of place to say here, gentlemen, that here is some cotton that did not come

through the Cotton Exchange. [Laughter.] You see how ragged it looks. [Referring to a specimen of the cotton plant with the bolls in various stages of development, which had been placed on the President's desk by Mr. E. B. WILBUR.]

Gentlemen, I take unusual pleasure, not in introducing to you, but in giving the space which I occupy on this platform to our old friend, SAMUEL T. HUBBARD, Ex-President of the New York Cotton Exchange. [Applause.]

Mr. SAMUEL T. HUBBARD. Mr. FISH and gentlemen, it is indeed a pleasure to me to be able to greet you in the city of New York and it is more — it is rather a filial pleasure for me to greet you within these walls. For this building was selected, purchased and furnished for its original occupants, the New York Academy of Medicine, by my father. [Applause.]

I spoke so long last year to you in Boston and took so much of your time that there scarcely remains anything for me to present upon the subject which has long been nearest and dearest to me — the affiliation between the cotton spinners of the United States and the different cotton exchanges. We here are only too happy to greet you. We wish to know you. We place our Exchange at your disposal, as the President has just said. We trust you will come down and see our methods of conducting business and realize that there is often an opportunity, as your Presfdent has said, to dispose of some of your surplus products to the members of the New York Cotton Exchange, because although the American spinner does not always — in fact I have never known him to sell the raw material as a hedge against the surplus stock of goods which he has on hand — but it is not an unusual, in fact it is a very usual act on the part of the Manchester spinner to sell in Liverpool cotton against his product of yarns when he finds it impossible to dispose of that product. We have a very complete system of classification. We handled in New York last year some two hundred and odd thousand bales of cotton which were classed by our paid experts, six in number, whom we pay $3,000 a year apiece; and the

reclamations on that cotton for grade were, I think, less than $1,000. The cotton was shipped out, shipped to spinners abroad and in the East, and the reclamations amounted to only that small sum. I think you will be interested in watching the methods of classification and that in the future when you have questions arising between the shipper in the South and yourselves, you can feel that you have there among those six men a body of men totally independent, without any interest in cotton, whose livelihood does not depend upon the fluctuations in the market or the mutations of business, who give their time and attention to determining the simple question of grade and do it to the best of their conscientious ability.

Gentlemen, I trust we will have the pleasure of meeting many of you on the Cotton Exchange and I heartily second the invitation of our President for you all to come down and see us. I thank you. [Applause.]

The PRESIDENT. Gentlemen, I will now introduce to you Mr. JAMES F. MAURY, one of the Board of Directors of the New York Cotton Exchange and the Chairman of the Committee of Information and Statistics. [Applause.]

Mr. JAMES F. MAURY. I am greatly flattered, Mr. President and members of the New England Cotton Manufacturers' Association by being asked to say a few words upon a very dry subject. Our President, Mr. GWATHMEY, has luckily for you limited me to fifteen minutes, therefore your nap cannot be very long.

In these days, when business is contracted for so far ahead, it is very important for the spinner of cotton, the buyer of goods, the exporter of cotton, and the shipper of the manufactured article, to have a fairly correct idea of the prospects and promise of the growing cotton crop. Business must be founded upon truth and good faith. To be misled by false and erroneous crop reports is, in the long run, an injury to every legitimate interest concerned therein — whether planter, spinner or merchant.

I am to speak upon, How to Report the Cotton Crop. I could easily take two hours and not do my subject justice, but as I am limited to fifteen minutes you must have mercy upon me for the bareness of my remarks.

Cotton grows in all kinds of land — light sandy, heavy clay, level prairie, high rolling land, river bottom land and swamps, canebrake lands, buckshot lands, black prairie, etc., etc. With a favorable season it yields well on all, but what is good for one is often bad for another. The cotton plant having three crops, a bottom, a middle, and a top crop, has more chance and power of recovery or making up for damage than any other great commercial crop. It starts in May and picking is rarely over till January, and in large crops, lasts into March. It has many drawbacks and sources of damage, but the three greatest are a cold, wet May, (giving a bad start,) a drought in summer, and an early killing frost for a late crop.

These constantly changing aspects make the cotton crop a very interesting study, an annual puzzle which fascinates many people to try to solve year after year. No one succeeds always —the most careful student will have his years of dismal failure— because it is difficult for one person to get equally accurate information from all parts of the belt, and he may be too much influenced by the reports from districts where he is best posted.

But it is easy to map out a system by which crop reports could be made quite reliable, and those who make them up would become more skilled and more accurate every year.

The head man, or Chief, in Washington should be one thoroughly familiar with cotton in all its phases of growth on different soils and in many parts of the country. He should choose for inspectors a number of men, experts like himself, and should give them certain districts to travel over year after year, to observe very closely and carefully the state of the plant and the effects of the past weather upon it, and report to him in detail what they *see, not what they hear.* These men should be employed by the year and paid well, holding their positions by the carefulness and truthfulness of their reports.

Twenty such men would probably be enough for the whole country. They should be ready to start at a moment's notice to go and examine any part of their districts. Meanwhile the Chief in Washington should have very accurate tables kept of the dates and amount of the rainfall, and the maximum, minimum and average temperature throughout the cotton belt. The places to get these particulars from are carefully picked out so as to cover the best yielding cotton lands and show the effect of the weather upon the plant in the different districts.

Before the season opens the Chief should know the exact amount of winter rainfall at every station in the cotton region. His inspectors should have informed him whether the land has been well ploughed and prepared during the winter and is all ready for the crop; or the contrary, and therefore everything behindhand. Where fertilizers are used they have got returns from State inspection, railroads and country stores, and have given him a fair idea of increase or decrease. After planting is over they should compare many plantations with last season and give their best estimate of the acreage, whether increase or decrease. When the cotton is up and "chopping out" begins, the inspectors should examine the fields carefully and report upon "the stand," and so on throughout the season they should be always at work or can be sent out the moment any important change in prospects takes place in any part of the cotton belt. The Chief should study these reports and the weather very closely and draw his conclusions that the plant is making such and such progress for good or otherwise. The inspectors' reports come in regularly and confirm, modify or correct his inferences and show him, if wrong, the reason why. On the other hand, if an inspector's report is very different from his Chief's inference, he is at once called upon to give good reasons for the difference, or another inspector can be sent at once to re-examine the district. This will hold them to a strict account and allow no tampering with their reports. By this plan the Chief can at any time give an intelligent report of the crop prospects in every district of the cotton belt.

After killing frost the inspectors should go out again and study very carefully its effect upon the plant, and after getting their reports the Chief will be able to make a fair guess at the probable size of the crop, which can be modified later, if necessary, by the final developments of the crop in December. This is a *mere outline sketch* of how the thing can be done on a sensible, reasonable, businesslike basis.

If any of you gentlemen want to buy a mill and cannot examine it yourself, do you send to the town where it is and carefully question every inhabitant as to its buildings, machinery, capacity, etc., average the answers, and then think you know all about it? No! You send an expert to examine the machinery, a builder for the building, a lawyer for the title, and a real estate man for the land values.

We are apt to get very indignant with the Agricultural Bureau for its sensational and misleading reports, but if we will consider their system we will see that the fault lies there, and that, with the best intentions in the world to make a reliable crop report, it can hardly ever be right except by a happy accident, and its sources of information are so heterogeneous and irresponsible that it can never be of any real value.

The Statistician usually knows very little practically about cotton. The supervisors in the different states are chosen not because of their thorough knowledge of the subject. but because the local Congressman recommends them for the office. The inspectors under them are selected on the same general principles. Opinions as to the crop are gathered from thousands of people, a large majority of whom give them as they hope to effect the market. Probably not a single person is afterwards held to any responsibility for the accuracy of his report. These reports are sent to Washington, submitted to a host of clerks, men and women, appointed in like manner, who read them over *correcting obvious errors!* (We may fairly stop to ask, how do *they* know what to correct?) and tabulate them. The results are then summed up and averaged, and the final result is sometimes modified by the Statistician and sometimes not, and this i

essentially the Bureau report. It, of course, cannot be a real report of the *condition of the crop*. It is merely the average expression of several thousand persons as to how they thought the condition of the crop should be reported to the world at that date.

Is it possible to change this unfortunate system? This is a hard question to answer. It will require a radical reorganization of the cotton part of the Bureau, from the Statistician down, and the dismissal of very many clerks and probably all the officials in the South, who would be useless under the new system. A very severe practical examination would be necessary for appointment as an inspector. The proper man for Chief would be difficult to find and the highest character would be as necessary as knowledge and ability, because of the temptations to a man in such a position. But it can be done if ordered and carried out in good faith by the proper authorities. I am glad to say that a very earnest and competent committee from the West are now working to improve the grain reports, and if the cotton trade joins with them we may perhaps succeed in getting some improvement in those upon cotton. [Applause.]

The PRESIDENT. Gentlemen, I now wish to introduce to you a gentleman who has been connected with the New York Cotton Exchange for many years, who for a long period was its treasurer — Mr. WALTER T. MILLER, the father of the Exchange.

Mr. WALTER T. MILLER. Mr. President and gentlemen, that is a rather flattering introduction. I do not object to any part of it except to call a young men like myself the father of the New York Cotton Exchange. [Laughter.]

But it is perhaps just as true, notwithstanding. I had a good deal to do with the formation of the Cotton Exchange. I have been in the cotton business from infancy, I might say — almost from infancy. You know we have a theory, we who are cotton men believe that we are born to understand what the grades of cotton are. We do not learn it, we are born to it. Now I am

a believer in that. I don't know the time when I did not know my A, B, C's. I could tell you the date, probably, when I began to say I knew about cotton, but probably I knew it before that. Because I can recollect when the chief clerk in the concern in which I was brought up, said, "Why, Walter knows cotton." "Ah, what do you class that lot?" "So and so." "All right." That was the principal of the house. From that date he never classed any lot of cotton unless I was by his side and we classed thousands, hundreds of thousands of bales of cotton in our office. I do not wish to speak too much of myself, but what I propose to say, Mr. President, is this — to recall some of the things concerning the purchase of cotton. The practical object in life of the cotton spinner is to buy his cotton, to have that which he is going to spin, so that his superintendent cannot complain and so that his hands will not object and so that the out turn will be suitable for the market down here in New York, or in South America, or in India, or in China, or wherever it may be. And it is important to know how to buy cotton. I don't know whether there is anyone here who knew or ever heard of a gentlemen formerly of Boston by the name of JAMES K. MILLS. He lived a little short of a century ago, but no matter — you were talking about my being the father of the Cotton Exchange. Now I want to say a few things about the former methods of buying cotton and the present methods of buying cotton. I want to make a little contrast between these, so that those who choose can take advantage of the latest methods and the best principles on which to obtain the fibre which they wish to spin.

Mr. MILLS was the treasurer of several large mills at that time. He would come down with a number of other spinners on a Monday night boat—they did not travel on Sunday at that time — and on Tuesday morning he would come into the office occasionally whenever he wanted to buy cotton, which was not often. The central idea of the buying of cotton in those days was the time to buy it — the time to buy it. It was not that they had sixteen offers of $1\frac{1}{16}$ inches, and all that kind of thing,

and whether he should take TOM JONES'S or SAM WILSON'S or somebody's else, but it was the time taken. Cotton was cheap or dear in the mercantile judgment of the treasurer or of his associates, and he came to New York and he looked at cotton. Mr. MILLS came in frequently enough for me to know him. He would come in and look in our office and say, "Mr. BRIGHT, good morning, what have you got? What have you to say?" "Here are 200 bales so, 700 so, 300 bales so." He would look at the cotton, he was one of those who were born to know what the grades of cotton were and what he wanted to spin. I may even doubt whether every mill man knows what he wants to spin, [Laughter], what is the best thing for him to spin and so on. Well, he would look at the cotton and he would say, "Well, I will see you again, Mr. BRIGHT." He would come in a couple of hours afterwards, after having gone through perhaps five or six thousand bales of cotton and he would say, "Well, you had a lot over here of 700 bales." "Yes." "How do you think you can buy that?" "We can probably buy that so." "I will take it." He would buy 2,000 bales of cotton in 15 minutes in our office. He would come and say, "I will give you instruction about sending it as soon as I go on to Eastons." He would buy 5,000 bales before leaving New York and give me the instructions —I was the shipping clerk—what to do about it. That was done where there was a large interest. But there were smaller interests at that time; one man would come for 30, 40 or 50 bales and he would look through the market and find what he wanted.

Now we had the samples of the cotton. I want to say this, gentlemen, that I am a believer in buying cotton on samples. My experience is longer than I wish to say before this audience, but if I am the father of the Cotton Exchange it is at least 30 years, and it is so much more than that that I won't say anything about it. But I want to see the samples, I want to sell the cotton by the samples. I don't want to say it is $1\frac{1}{16}$ inch or $1\frac{1}{8}$ inch or anything like that and take out my rule to measure it and all that kind of thing. To illustrate what I mean, I know

whether the staple is good or not; I have bought thousands of bales of cotton without ever trying the staple; I know it. How? A gentleman came to me one day — I recall the circumstance — and asked, "What do you want this morning?" "I want 200 bales of middling Georgia." "I have got it," he said, and sent out for a sample and brought it to me. I looked at it and said, "The staple isn't good, it don't suit me." He got into a towering rage. "You haven't examined it," he said. I said, "I see the staple, and now to prove to you that I am correct I will show it to you with great pleasure. You needn't be angry with me; I know what my business is." I showed him the staple and he went away, perhaps rather sorry, but it was a fact that the cotton was not suitable for the purpose for which I wanted it, and I did not buy it.

Now I want to say, gentlemen, that in the New York Cotton Exchange — because I do not want to prolong these remarks too much — I was not limited like my friend, Mr. MAURY, and let me say a word about my friend, Mr. MAURY, before I go any further. Parenthetics are a bad thing, but I must enjoy the story just at this time. Mr. MAURY'S father was my financial father. His father was educated at Oxford. His father was the first Consul under General Washington at Liverpool.

Mr. JAMES F. MAURY. Grandfather. [Laughter].

Mr. WALTER T. MILLER. His grandfather, not his father. [Laughter and applause.] I said — if it was an Irish bull, forgive me, but I intended to say his father's father was the first Consul at Liverpool — not Mr. MAURY'S father, if you please. [Laughter.] However, I am personally under great obligations to his father, who was a great statistician, as was also his uncle. Mr. MAURY inherits the gift; it is in the family. They understand all about statistics. But I want to tell you a little joke about statistics, and I know my friend will forgive me because we are on the best of terms. You all know EDWARD ATKINSON. EDWARD ATKINSON was talking with me in the Fifth Avenue

Hotel one evening and we were discussing various matters connected with cotton, the probable crop and all that. He said, "I was going from Liverpool to London one day and I took a lot of papers out of my pocket and laid them on my lap. A gentleman looked across at me from the other corner of the railway carriage and said, 'Sir, pardon me, are you a statistician?'" "Well," Mr. ATKINSON said, "a little that way." "Oh," said the other, "Pardon me, but we are professional statisticians; there is our card," they were located at Nottingham or some other interior town. Said he, "We get up statistics on any conceivable subject — to prove anything you like." [Great applause and laughter.]

Now I want to say to you in reference to statistics, that you can prove by them anything you like. I am entirely opposed, out and out, to the statistics which are provided by the United States Government at the present time. They are utterly misleading, because I believe many times they are inspired — not by the statistician or to him, but by the gatherers of the information. I say that here now because I believe it. I say it, and that is the reason why they are not reliable. Mr. MAURY is too modest. I am not quite so modest.

Now the practical point with which I would like to bring my remarks to a close is this, that following all these years, because there has been no point in the history of the time that I have been in the trade that I have not been just as close up to the point of new methods of business as it was possible to be; very likely and very frequently I suggested some of them, and it would be for some one else to say what those were. And now in the New York Cotton Exchange I would like to intensify some remarks made by Mr. HUBBARD. It is in reference to purchasing cotton that is delivered on contract in the city of New York. Let me give you my personal experience out of that. I think we shipped certainly 5,000 and probably 7,000 bales out of the deliveries of August. Our methods are to ship to the other side of the water without weighing; I am perfectly content with the classification, satisfied with the conditions of

the contract, and if in any particular case I do not like the character of the cotton I have bought it and received it — that is, I have received a certificate for a hundred bales of cotton; and I get the samples of that cotton and I look at it and examine it, and if I don't like to ship it to your mill, I don't; I keep it and sell it. If for any reason, while the classification may be correct, but you are in doubt about the staple and body and character and working qualities, that can all be ascertained here in the New York Cotton Exchange. We ship, as I tell you, many thousand bales, and the claims which come in are hardly any. I can say, Mr. President, that I have personally shipped, boy and man, many thousands of bales of cotton and I never had a claim of $5 in my life on anything I ever shipped. I had a claim on one bale of cotton once, out of a lot supposed to be of thirty bales. It was a lot shipped to a small mill near Worcester and the owner of the mill came to my office one day after we had shipped it and he opened a paper of cotton and said, "Mr. MILLER, I am perfectly astonished that you should ship me such a bale of cotton as that." Said I, "I guess we didn't ship it." "Oh," said he, "it is one that you shipped, and it is down here on the wharf; I have had it shipped back." Well," I said to him, "we will send over and see." His particular mark, of course, was on his tag, and I sent the man who had selected the cotton, because it was a selection out of a lot of cotton, and he brought the tag of that cotton, and it was to stop at Worcester, but it was marked "Diamond B. Boston." That is the only claim I ever had. [Laughter.] He put it in his pocket and took back the bale of cotton and told the railroad to get for him the bale that they had given to somebody else.

Now I want to say that that can be done by anybody who is willing to attend to his business as he ought to, and you can do it; that is, if you will make up your mind to look into the methods and investigate plans of buying cotton under a contract and receiving that which suits you or employing a suitable person to choose it for you in the selection. You cannot do that on five bales of cotton; you must do it on more than five.

You can do it better on five hundred than you can on five or one hundred, of course. And investigation is courted so that this shall be done. The interest of the New England spinner today, in my opinion, is closely bound up with having a large stock of cotton not far away from the mills. How will you get it? In the first place, we are trying to get such concessions from the railroad as to give the buyer of one hundred bales or five bales the advantage of the through rate from the town in the South where it is shipped to your mill. That is what is called under the through bill of lading system. And we propose to bring a great deal of cotton to New York, not only that way, but that it eventually may be shipped to Bremen, to Liverpool, if you assist us.

But let me say — and pardon me for being too lengthy, Mr. President — there is, as I have known for thirty years, an intense prejudice against buying cotton in New York — why? Because the treasurer takes up his mail in the morning and finds he has so many offerings, it is all so much per pound landed in the mill. But if we sell it to him we have got to tell him that there is a small charge for commission and brokerage; there are various other things; we may sum it all up — because we have got to compete with this idea. But he looks at that and then who does he buy it of? If he buys it in New York, you see the idea — you have got the responsible man, you have got the classification, you have got the fund which is behind the classification committee for a claim, if you should have any. You all know there are two sides in a bale; when you buy your cotton you buy by the poor side in the bale. I could amplify all this to a great extent, but I merely throw out the idea because I know that the interests of the New England spinner today in the competitions with the southern producer of goods are such that you want to take advantage of every opportunity. And now if you will excuse me, Mr. President, and forgive me for the length of my speech I will sit down. [Applause.]

The PRESIDENT. Gentlemen, we have with us a member of the New York Cotton Exchange who perhaps feels himself so closely allied with the cotton spinners that he is sitting with them, and I wish to introduce to you Mr. L. L. FLEMING, who will speak to you a moment.

Mr. L. L. FLEMING. Mr. President and gentlemen, I overheard a remark in the Cotton Exchange this morning, "How did that round bale man get on the speaker's list?" It matters not how I got on; suffice it to say there is no partisanship brought here tonight and this is not the occasion for a man to exploit his wares. The duty of this occasion is for us all to get together and cement as far as possible the tie which seems to be bringing the New England cotton spinner and the New York cotton market closer every day. There is no question of the advantage that must accrue to the New England spinner to have a spot market so near to him as New York, a market which would be stable and on which he can, when conditions favor, buy his cotton as the Lancashire or the Manchester spinners get theirs in Liverpool.

The English spinner buys considerable cotton on a specified grade for direct shipment to mill from this side just as the bulk of the American spinners do, but, having always a large stock of classed out or "even running" cotton in Liverpool to select from he unquestionably takes the greater portion of his wants there, buying same on samples or equal to certain previous purchases of a particular contract grade.

Carrying as I have stated, always a large stock, the Liverpool contract market is not open to continual corners and manipulations, it changes with actual spot values and is practically a stable market.

The English spinner appreciating this situation buys a large percentage of his cotton "on call" at a certain parity over or under the market, as the case may be.

This method of trading (not new to all of you) is to contract for your wants ahead and name the price when it suits you at so much on or off the month of delivery or the position agreed on.

I am not undertaking to advocate this as the best method of buying cotton at all times but there can be no question as to the advantages it offers under many conditions.

It is not always convenient either from scarcity of funds, insufficient warehouse room, etc., to take care of six to eight months spinning supply, from the first of January or February until the new crop moves.

The question is how can we obtain these stable conditions in the New York market.

Answer. By maintaining a large stock of cotton in New York.

How can this be accomplished?

Answer. First, by such an adjustment of freight rates as will make the cost of stopping cotton in New York and subsequently forwarding to the mill, no greater than the cost of direct shipment from originating point to mill. (This has been accomplished.)

Second, by bringing the cost of stopping cotton in New York nearer to the cost in Liverpool, in the South, or at the mill.

(The New York Cotton Exchange is now working to this end.)

Third, by a willingness of the American spinner, when conditions favor, to buy cotton out of New York stock, or based on New York contracts, as the English spinner does in Liverpool.

(This inclination we hope to see fostered by this meeting.)

Remembering the old adage, "It is an ill wind that blows no good," I would offer our New York Cotton Exchange friends a few works of consolation in that at the moment they are very much disturbed over a little excitement which is due to arrive sometime the first of the year, probably in January; we are looking for it. I would remind them that every cloud has its silver lining. Even though this calamity we are looking forward to may come, it will not be without some compensating results and advantages. If this deal is successful, it must bring a very large stock of cotton here. If it is not succcessful, the consternation and the dread and the demoralization which the Exchange has suffered here in the last sixty days will open the eyes of the trade to the fact that they must have a stock here, and a large

stock. And then for Mr. MILLER'S satisfaction I would suggest that wheresoever the big stock of cotton is, there will the buyers be gathered together.

I will not go into the details of this new substitution plan, about which so much has been said, no doubt it has been discussed already, and further, I understand that a smaller committee of each one of these bodies is to talk that matter over at some later date, during this week.

There is one subject which I have not heard discussed (though it may have been brought up by some one preceding me) which strikes me as a feature that seems to be escaping the attention of the New England spinner. Cotton may be bought today landed in Liverpool or Bremen just as cheaply as in Boston or Lowell or Fall River. That cotton is carried three thousand to thirty-five hundred miles further, and yet it can be put there just as cheaply as to your mill. This brings up the thought that consolidations or trusts, or by whatever name we shall call them, control the rail lines and probably also the coastwise steamship lines; a uniform rate is laid down by which they all must be governed, but there is no executive board which passes on what rate a tramp shall charge from Galveston to Bremen, and this is where your disadvantage lies. I do not propose to suggest a remedy for this problem, but bring it up as a point that merits much attention.

The PRESIDENT. Gentleman, we will now adjourn until 9.30 tomorrow morning.

SECOND SESSION.

WEDNESDAY MORNING, OCTOBER 1, 1902.

Meeting called to order at 9.30 A. M., President FISH in the chair.

The following papers were read:

The Lubrication of Textile Mills.
WILLIAM F. PARISH, Jr., Boston, Mass.

Discussed by Messrs. GEORGE OTIS DRAPER, THOMAS H. SMITH, JOHN E. PREST, CHARLES H. FISH and FRANK A. BOWEN.

Observations on Spindle Banding.
WILLIAM D. HARTSHORNE, Lawrence, Mass.

Discussed by Messrs. GEORGE OTIS DRAPER, JOHN E. PREST, THOMAS H. SMITH and C. J. H. WOODBURY.

The World's Supply and Consumption of Cotton.
S. N. D. NORTH, Supt. Department of Manufactures, United States Census, Boston, Mass.

Discussed by Messrs. WILLIAM D. HARTSHORNE, CHARLES H. FISH and THOMAS H. SMITH.

Preparation of Cotton for Carding and Spinning, especially Egyptian Cotton.
JOHN J. CONNELL, Lowell, Mass.

Discussed by Messrs. CHARLES H. FISH, JOHN E. PREST, THOMAS H. SMITH and EUGENE C. ANDRES.

THIRD SESSION.

WEDNESDAY EVENING, OCTOBER 1, 1902.

Meeting called to order at 8.15 P. M., President FISH in the chair.

The following papers were read:

Our Foreign Commerce in Cotton Goods.
O. P. AUSTIN, Chief Bureau of Statistics, Treasury Department, Washington, D. C.

Mill Construction on the Continuous Skeleton System.
SANFORD E. LORING, Syracuse, N. Y.

Discussed by Messrs. T. H. SMITH, ARNOLD B. SANFORD, JOHN E. PREST, CHARLES H. FISH, ARTHUR H. GULLIVER, CHARLES H. MERRIAM, Jr., and JOHN W. FRIES.

Bleaching and Finishing of Textile Fabrics.
ARTHUR C. FREEMAN, New York City.

Discussed by Mr. JOHN W. FRIES.

The Card System in Mill Supply Accounts.
FRANK P. VOGL, Claremont, N. H.

FOURTH SESSION.

THURSDAY MORNING, OCTOBER 2, 1902.

Meeting called to order at 9.30 A. M., the President in the chair.

The SECRETARY. Mr. President, I have a letter which will be read by the direction of the President.

To the Members —

For the purpose of introducing the high standard of our textile instruction to the representative cotton manufacturers of the country, we will extend to each member of the New England Cotton Manufacturers' Association the privilege of nominating one employee for a scholarship in any of our textile courses, the regular price of which is fifty dollars. The school will waive all charges for tuition, the student's only expense being the cost of instruction papers (furnished as he progresses) and postage. This amounts to seventeen dollars.

We make this offer in the confident belief that a practical demonstration of the value of our instruction will win for our school the endorsement of every progressive manufacturer.

This offer is limited to October 15th.

AMERICAN SCHOOL OF CORRESPONDENCE.

Boston, Sept. 30, 1902.

The following papers were read:

Tension on Roving Frames.
WILLIAM E. WINCHESTER, Philadelphia.

Discussed by Messrs. JOHN E. PREST and THOMAS H. SMITH.

The Under Feed Stoker.
GEORGE C. TEWKSBURY, Boston, Mass.

Discussed by Mr. ALBERT A. CARY.

Testing of Cotton Yarns.
GEORGE R. SMITH, Bradford, England.

The Management of Mills.
CHARLES W. DENNETT, North Adams, Mass.

Discussed by Messrs. CHARLES H. FISH, SANFORD E. LORING and WILLIAM D. HARTSHORNE.

The SECRETARY. The following notice has been served upon me:

Notice is given to the Secretary, in accordance with Article 15 of the Constitution and By-Laws, that it is proposed to introduce at the annual meeting of the Association the following amendment to the Constitution and By-Laws:

In Article 1, after line 3, insert "in the American Cotton Manufacturers' Association."

The purport of this, as I understand it, is that it is proposed to introduce a motion to change the name of the Association from the New England Cotton Manufacturers' Association to the American Cotton Manufacturers' Association. The by-laws require a notice of a motion for amendment to be given at this meeting, and advance notice to be issued to every member before the annual meeting, and the adoption requires a two-thirds vote of those members present at the annual meeting, and this is given as a matter of record.

On motion of Mr. M. F. FOSTER, duly seconded, it was voted that the President appoint a committee on resolutions, consisting

of three members, to report resolutions of thanks to those who have extended courtesies to the Association during the present convention.

The President appointed as such committee Mr. J. R. MONTGOMERY, Mr. M. F. FOSTER and Mr. R. M. MILLER, Jr.

FIFTH SESSION.

THURSDAY AFTERNOON, OCTOBER 2, 1902.

Meeting called to order at 2.30 P. M., President FISH in the chair.

Mr. WILLIAM D. HARTSHORNE. Mr. President, referring to a paragraph in the President's address in regard to the matter of uniformity of accounts, I would like to offer this motion:

"That the President appoint a committee of five to consider and report upon a standard form of keeping manufacturing accounts."

In making this motion it might be well for me to state some additional reasons for it. Undoubtedly it is true that none of us would claim that we have the best system of accounts that could be desired, and if we could find something better we should be glad to know about it. There often come inquiries to the larger concerns as to how they keep such accounts and asking for advice in regard to how to handle such matters. More than that, individual concerns will often wish to compare statements as to costs, but if they are on entirely different bases it is almost impossible to make any such comparison. If some uniformity of methods were used such comparisons might be of use when it was agreeable to both parties to make them.

The motion was seconded by Mr. E. W. THOMAS and being put to vote was adopted.

The PRESIDENT. In carrying out this vote I would ask a little time for the election of the members of this committee.

Next in order is the balloting for new members. I will appoint, if you please, Mr. FRED LACEY and Mr. P. T. CREED to distribute and correct the ballots. The names which appear on the ballots have all been passed upon and reported favorably by the Board of Government and are qualified for membership or associate membership, as the case may be.

The committee proceeded to the discharge of their duties and having attended to the same reported that all ballots cast were in favor of all the candidates for membership.

The PRESIDENT. I declare that the following was the list of candidates for membership and associate membership have been elected.

FOR ACTIVE MEMBERSHIP.

G. H. T. BABBITT, Asst. Supt. Chicopee Mfg. Co., Chicopee Falls, Mass.
By Mr. HENRY A. BAILEY.

V. T. BARBER, Supt. Slater Cotton Co., Pawtucket, R. I.
By Mr. ROBERT BURGESS.

A. E. BOSWORTH, Supt. Bernon Mills, Georgiaville, R. I.
By Mr. A. H. GULLIVER.

S. PARKER BREMER, Treas. Monadnock Mills, 4 Winthrop Sq., Boston
By Mr. BENJAMIN PHIPPS.

HALSEY CONNETT, Supt. Clark Mile End Spool Cotton Co., East. Newark, N. J.
By Mr. E. Y. WOOLLEY.

O. D. DREW, Supt. Peabody Mfg. Co., Newburyport, Mass.
By Mr. GEORGE E. SPOFFORD.

JAMES B. DUGGAN, Pres. Union Bleaching and Finishing Co., 41 Jewett Place, Utica, N. Y.
By Mr. A. C. FREEMAN.

LOUIS I. GUION, Supt. Columbia Mills, Columbia, S. C.
By Mr. W. B. SMITH WHALEY.

JOSEPH B. JAMIESON, Mgr. Boston Office of New England Cotton Yarn Co., 77 Bedford St., Boston, Mass.
By Mr. ARTHUR H. LOWE.

ARTHUR H. MASON, Treas. Barnaby Mfg. Co., Fall River, Mass.
By Mr. GEORGE H. HILLS.

ALBERT E. MCDONALD, Agt. Lawrenceville Mfg. Co., Lawrenceville, Ga.
By Mr. WILLIAM WHITTAM, Jr.

JAMES A. MCLANE, Supt. Davis Mills, Fall River, Mass.
By Mr. J. B. RICHARDS.

JOSEPH MERRIAM, Pres. Springfield Webbing Co., Middletown, Conn.
By Mr. J. R. MONTGOMERY.

PARDON B. SANFORD, Supt. Utica Spinning Co., Utica, N. Y.
By Mr. GEORGE E. FARRELL.

R. IRVING TOBEY, Mgr. Cold Spring Bleaching and Finishing Works, Yardley, Pa.
By Mr. GEORGE E. SPOFFORD.

M. J. TOOHEY, Mfr. Rope, Twine and Banding, Fall River, Mass.
By Mr. JOSEPH H. POTTER, Jr.

FOR ASSOCIATE MEMBERSHIP.

ALBERT BIRCH, Somerville Machine Works, Kent St., Somerville, Mass.
By Mr. C. H. FISH.

EDMUND E. BLAKE, Selling Agt. Saco & Pettee Machine Shops, Newton Upper Falls, Mass.
By Mr. F. J. HALE.

MELVIN H. COFFIN, Selling Agt. Whitin Machine Works, Whitinsville, Mass.
By Mr. WILLIAM D. HARTSHORNE.

WILLIAM DRESSER EDWARDS, New England Representative Buffalo Forge Co., Board of Trade Bldg., Boston, Mass.
By Mr. C. H. FISH.

JOSEPH FOSSEL, Cotton Machinery Expert, 152 Congress St., Boston, Mass.
By Mr. WALTER RIGBY.

WALTER MAXWELL HASTINGS, Principal Textile Department, American School of Correspondence, 156 Tremont St., Boston, Mass.
By Mr. ROBERT F. WEBSTER.

THEODORE H. PRICE, Cotton Dealer, 71 Wall St., New York, N. Y.
By Mr. C. H. FISH,

ARTHUR TURNBULL, Mgr. John J. Keller & Co. (Incorporated), 56 South Water St., Providence, R. I.
By Mr. WILLIAM R. NOONE.

The following papers were read:

The Export of Cotton Goods.
WILLIAM P. WILSON, Sc. D., Director, Philadelphia Commercial Museum, Philapelphia, Pa.

Cotton Mill Expansion.
ARNOLD B. SANFORD.

Mr. J. R. MONTGOMERY. I offer the following resolutions on behalf of the Committee on Resolutions:

Resolved, that the thanks of this Association be and are hereby extended to the American Society of Mechanical Engineers for the use of their rooms and for the kindly greetings and courtesies shown us.

Resolved, that the special thanks of this Association be and hereby are extended to Mr. JAMES M. DODGE of Nicetown, Philadelphia, Vice-President of the American Society of Mechanical Engineers; Mr. J. TEMPLE GWATHMEY, President of the New York Cotton Exchange; Mr. S. N. D. NORTH, Superintendent of the Department of Manufactures, United States Census, Boston, Mass.; Mr. O. P. AUSTIN, Chief of the Bureau of Statistics, Treasury Department, Washington, D. C., Mr. GEORGE H. SMITH, Bradford, England, and Dr. WILLIAM P. WILSON, Director of the Philadelphia Commercial Museum, Philadelphia, for interesting and instructive addresses at this meeting.

J. R. MONTGOMERY,
M. F. FOSTER,
R. M. MILLER, JR.
Committee.

The resolutions were put to vote and unanimously adopted.

The PRESIDENT. Is there anything further Mr. Secretary?

The SECRETARY. I do not think of anything further, except if any of the gentlemen wish sets of advance copies of the papers I shall be glad to furnish them. I have a few of the members' badges left and will supply them to any one who wish them to take to absent members.

The PRESIDENT. I now declare the convention adjourned *sine die*.

Adjourned,

Attest:

C. J. H. WOODBURY,

Secretary.

TRANSACTIONS.

SECOND SESSION.

WEDNESDAY MORNING, OCTOBER 1, 1902.

The Association met at 9.30 A. M., the President in the chair.

The PRESIDENT. We will now proceed to the presentation of papers. The first paper on the morning's programme is "The Lubrication of Textile Mills," by Mr. WILLIAM F. PARISH, JR., of Boston, Mass.

LUBRICATION OF TEXTILE MILLS.

WILLIAM F. PARISH, JR., Boston, Mass.

COPYRIGHT, 1902.

During the last ten years much has been written upon the subject of lubrication from a theoretical standpoint; many tables have been prepared showing co-efficients of friction determined by using various lubricating materials upon various friction testing machines. All of this matter has a value in showing the range of work which lubricants can be made to cover, and for the scientifically inclined it presents an interesting field for study. Lubricants can be selected that will give a range of readings from the very lowest co-efficients to the highest that it is possible to observe upon the testing machines in use. These machines are primarily intended as laboratory instruments, and in this field

---

* For other papers on the subject of Lubrication, reference is made to the Transactions of the Association in papers by

A. G. CUMNOCK, Vol. 5, page 23; BENJAMIN SAUNDERS, Vol. 5, page 24; Statistical Table, Vol. 6, page 44; DANIEL HUSSEY, Vol. 10, pages 7 and 42; ROBERT JOHNSTON, Vol. 11, page 13; F. J. RABBETH, Vol. 14, page 16; SAMUEL WEBBER, Vol. 15, page 35; EDWARD ATKINSON, Vol. 24, page 17; Prof. J. M. ORDWAY, Vol. 25, page 17; Table of Costs, Vol. 25, page 60; Prof. J. M. ORDWAY, Vol. 26, page 17; EDWARD ATKINSON, Vol. 26, page 37; Vol. 27, page 27; C. J. H. WOODBURY, Vol. 27, page 42; Vol. 28, page 58; CHARLES N. WAITE, Vol. 28, page 85; EDWARD ATKINSON, Vol. 35, pages 41 and 59; WILLIAM F. DRAPER, Vol. 44, Page 15; W. N. GODDARD, Vol. 44, page 18; EARL A. THISSELL, Vol. 44, page 27; F. M. MESSENGER, Vol. 49, page 52; A. M. GOODALE, Vol. 52, page 59; Vol. 53, page 7; C. J. H. WOODBURY, Vol. 53, page 13; A. M. GOODALE, Vol. 54, page 80; C. J. H. WOODBURY, Vol. 54, page 82; JOHN T. MEATS, Vol. 58, page 301: WILLIAM WELCH, Vol. 58, page 305; D. D. Donovan, Vol. 63, 216; RUSSELL W. EATON, Vol. 67, page 209.

have a decided value in proving to the technical student that one set of lubricants will give different results from another under duplicate conditions of pressure and speed.

While these friction testing machines are valuable in their special field, their readings are of little value when used to determine what lubricants should be applied for practical work.

A striking example of the limitations of testing machines is shown by the following: Lubricants offered to a foreign corporation were continually rejected, and upon investigation it was found that this was because the co-efficients were high as compared with certain required book standards. As the oils were to be used for lubricating car journals, the following questions were asked in regard to the testing machine:

Was the pressure over the entire bearing surface uneven?

Was the atmosphere surrounding the instrument bearing alternately cooled and heated; was it wet at one time and dry at another; was it dusty?

Was the speed variable?

Was the bearing treated with neglect?

These conditions the rejected lubricants were intended to cover.

As a matter of fact, the bearings of the machine were nicely ground; the pressure was evenly distributed by a clever arrangement of levers; the atmospheric condition was constant; the speed varied throughout a uniform range; and the oil was carefully measured out and the bearing flooded in a clear bath. All these conditions would be exactly the reverse in actual work.

There are instances where oils have been adopted for mill work from the results of tests upon friction machines. These oils, afterwards, have been replaced by other lubricants and considerable power saved as a result. Another instance is recorded where the best possible lubricant for the required purpose was rejected on account of its high co-efficient as compared with that of a combination of light spindle and kerosene oil, an impossible practicable lubricant.

Many difficulties arise from selecting oils for actual work by

depending upon the comparative oil chemist. His reports are based upon characteristics of the given oils, and a selection made from such reports is made with an idea that greater or less reading of characteristics, such as temperature, gravity, or viscosity, proves the superiority of one lubricant over another for any given work. Gravity, viscosity, or temperature tests do not indicate the lubricating value of an oil, they are simply some of its physical properties.

The value of the oil chemist is in checking the various stages in the process of manufacturing the oil, and in this field his services are indispensable, as he protects both the manufacturer and purchaser from too wide a variation from the fixed standard. Should all oils be examined by the purchaser, through the chemist, it would be found that in consecutive shipments of certain classes of oils that one consignment would vary more from the standard than another. Every characteristic of a certain oil has its standard reading, a variation of so many points each way being allowed by the manufacturer. The oil manufacturer who produces only lubricating oils will allow but little variation from his standard, while oils not primarily intended for lubricating purposes will vary so much from their standard readings that they might almost be classed differently.

Oils are classified as fixed and volatile. The fixed oils include the animal and vegetable oils and are not capable of distillation; volatile oils include the essential oils and petroleum.

Petroleum oils may be divided into two general classes; residual and distillate oils. The residual oils are products remaining after the light properties have been distilled off. There are almost unlimited variations in the character of residual oils, governed first, by the grade of the crude oil itself, and secondly, by the manner of distillation and subsequent treatment, which may vary from the most complete fractional distillation used in the manufacture of lubricating oils, to that destructive distillation employed in the manufacture of burning oils, giving petroleum tar as the residual product.*

* "About Lubrication, from the standpoint of a manufacturer of Petroleum Lubricants."— C. M. EVEREST; John Wiley & Sons, 1893.

Distillate oils are of two classes; the paraffine oils made from distillation of the tar previously referred to, and afterwards deodorized and decolorized by chemical treatment, and the neutral oils which are made from an intermediate distillate produced in fractional distillation.

It is possible to duplicate an oil to within the variation allowed from the standard readings for that oil, duplication being in color, weight, and all the known physical tests; yet upon actual work, where the requirements are exacting, the duplicate will break down completely, while the original will stand up to its work.

The most practical method of making a selection of lubricating oils is by an actual trial upon the machines to be lubricated. Sometimes these trials are very crude. Out of a large number of oils offered, one is selected that will stay on a bearing the longest; no observation is made except as to its lasting quality. While it is selected upon a comparative basis, a determination as to lasting quality does not necessarily signify that the oil is the best to use. Some selections are made after drying known quantities of the samples submitted, the purpose being to secure a non-gumming lubricant. Perhaps the method most widely used is to place the samples in the hands of the machine operators with instructions to watch the oils carefully. The difficulties in selecting lubricants in this way are that no ordinary operator is capable of judging the different stages of lubrication. Oil is reported upon as "all right", "no difference", or, "it will not work". There might be ten oils that were all right, yet one would be much better than the others. In some mills where a practice is made of accepting all samples offered, the operators lose interest and send the office the same report upon all.

For instance: one mill had for an agent a man who was constantly looking for something better for lubricating purposes than he already had, but he took a wrong method of determining the comparative value of the material offered. On cylinder oils where the trial was based upon the amount of oil used for a specific work, the report given by the operators on 19 samples

was that they could see no difference in the feed,—for the very good reason, unknown to the agent, that they had always set the lubricators to feed so many drops per minute. The 20th oil fell down and they had to feed twice as much. They discovered the particularly bad oil, but they made no distinction between the other oils which must have run from almost bad to very good; consequently no value was received by the agent from the trials.

Sometimes in changing oils and depending upon operators for a decision as to their comparative value, a wrong impression is made by the action of the new lubricant upon the deposits left by the old oil. This deposit in working out is very often charged up as belonging entirely to the latest lubricant, and a report is made to that effect.

Another very peculiar circumstance has been actually met with a number of times in mills where the method of lubrication has been an established factor for some years. A change of one set of oils having been made and an adverse report having been sent the office by the operators, an investigation developed the fact that the hot bearings charged up to the new oil were not included in the test and had never had anything but the old oil upon them. They had been left undisturbed until the attention of the operator was called to the lubrication problem.

There must be some general system established by which the effect of lubricants can be determined in a practical manner. It must be along well defined lines, and must be free from the personal factor item, from prejudice, from lack of interest, and from a too great amount of theoretical practice. Lubricants should be selected upon a basis of what they will do upon actual work towards reducing the frictional item to its lowest point. They should also be selected with an additional end in view:—that the frictional item should remain practically a constant, *i. e.* the lubricants should not vary in quality, nor deteriorate during use, nor leave any deposit. The method of using them should conform to the class of work and to the results desired.

In treating the subject of lubrication from an engineering

standpoint, using oils as a means of reducing the frictional horse power of a textile mill, and making the different adaptations with a view of securing the lowest loss of power possible under running conditions of the mill, it is necessary that different classes of machinery be lubricated with oils of different characters.

It is impossible to more than generalize in regard to what special lubricants should be used for a textile mill, as the mechanical condition of each plant is a factor which will make it impracticable to treat all mills exactly alike. The machinery may be grouped, and the classifications of lubricants should generally be as follows:

High Pressure Cylinder Oil.
Low Pressure Cylinder Oil.
Engine Oil.
Dynamo or Motor Oil.
General Lubricant for Heavy Machinery.
General Lubricant for Light Machinery.
Shafting Oil.
Loom Oil.
Bath or Closed Spindle Oil.
Oil for Heavy Open Spindles.
Oil for Light Open Spindles.
Top Roll Oil.

CYLINDER OILS.

The following general conditions must be considered in making a selection of cylinder lubricants: Location, size, and type of unit; general condition of cylinder and valves; pressure of steam; condition of steam; use of exhaust; method of oil feed.

The determination of the efficiency of cylinder lubricants is made by the manner in which the valves and piston operate during the run and by an inspection of lubricated surfaces after the run.

The lubricant should possess body and spreading qualities, and be able to remain upon the walls of the cylinder and upon the faces of the valves under the temperature and conditions of

entering steam. It should not volatilize under working conditions, and it should not leave a resinous or tarry deposit upon the valves or in the cylinder clearance. The oil may be slightly compounded or not, as the condition of the plant may require. Compounding with the proper amount and kind of fixed oil adds to the lubricating value of a cylinder oil, but when the exhaust is returned to the boilers through a surface condenser and closed heater, as in all marine practice, a fixed oil in any amount or condition is detrimental to the efficiency of the boiler, and a cylinder oil composed of straight mineral stock should be used.

Oils must be adapted to the pressure and the condition of the steam used. High pressure cylinders of multiple cylinder units require an oil that will work with the temperature of the entering steam. Oil for the intermediate or low pressure cylinders should be of an entirely different character, one more suited to the low pressure of steam and one that will work in harmony with the oil carried over in the exhaust from the high pressure cylinder.

The amount of feed depends upon the condition of the engine and the steam, the character and the adaptability of the oil for the work, the style of the lubricator, and upon the engineer in charge.

A badly worn engine using wet steam will necessarily consume more oil for a given condition than an engine in good order using dry steam.

A light oil for high pressures will require a greater amount of oil to furnish the same amount of lubrication as a viscous oil. Overfeeding a viscous oil will usually produce an effect the opposite from that desired. Underfeeding a light oil will add to the abrasive friction of the engine. Feed of cylinder oil should be regular.

ENGINE LUBRICATION.

Engines may be classed as high, medium, and slow speed; and the oiling system as automatic and hand. Slow engines in-

clude the Corliss and similar types; medium, the Buckeye and similar types; high, the Ball & Wood, and similar engines.

An oiling system may be considered automatic where the oil is sent to the surfaces to be lubricated, caught after use, cleaned by filtration, and returned to the lubricated surfaces by force or by gravity. Sight drop oil cups and open cups or bearings constitute the hand oiling class.

The high speed engines are, as a rule, of the crank case type, or are made practially enclosed by the use of oil guards or covers. Lubrication upon these engines approaches very nearly the oil bath. They should be fitted with a diaphram or a double stuffing box so that the oil will not throw against the cylinder head, as the oil, in order to meet the lubrication condition of these engines, will not be sufficiently heavy to withstand the heat of the cylinder. Provisions are made on all the modern types of this class of engine to keep oil in circulation. In some types after the oil has run through the bearings it is passed through a small filter and pumped back to the crank case. The lubricant that is adapted to these engines should be a quick acting, pure mineral oil, and should show clear after use. Water should separate freely from it, and it must not develop any decided tendency to thicken. An oil that is properly made for this work will last indefinitely, as far as wearing qualities are concerned.

The medium speed engines require a little heavier lubricant, if oiling is done by hand, *i. e.* through sight drop oil cups. If the engine is fitted up to catch the oil after it has been used, a high grade, indestructible oil should be adopted. This should be caught, filtered to remove dirt, etc., and reused. It should be an oil that will not break down through continued service, and should retain its color, thicked but slightly, and contain no fixed oil, *i. e.*, animal and vegetable oil.

An oil for the heavier types of engine should be greasy, rather quick acting, and should withstand pressure. If an automatic system is in use, the oil may be quicker acting, so as to produce a bath effect instead of a drop film.

Wherever possible, and where the greatest efficiency is desired, the drip for condensation and cylinder oil under the stuffing box should be separated from the drip from the guides. It is an easy matter in designing frames to allow for a short rib just behind the lower guide which will be the separating point for cylinder oil and engine oil. Should an engine not be arranged to catch all the oil, a lower grade can be used, but as a rule the lower grades of engine oils will not stand continued service although they will do well enough if used only once. The practice of using an engine oil, catching it and using it again upon shafting and machinery in the mill is not good economy.

Oils containing fixed materials leave a varnish like film upon all bright work, and leave a pronounced deposit in the pipes and oil cups. Engines fitted with a gravity feed system and using an oil of strong gumming tendencies, have to be given extra care owing to the danger of the oil feed stopping. Very frequently the piping has to be removed, and scraped to secure a free flow of oil. Changing oil where this has been the case requires some care; the oil, unless it contains the same amount of fixed product, will act as a cleanser, loosening up the deposits in the system which will settle into the regulating gage of the cup, and cause a stoppage of the feed. The piping should always be removed and cleansed thoroughly before changing from a gumming oil to one of different character.

Animal oils, or oils prepared by the use of acids, will attack brass and stain the bright work of engines.

DYNAMO OIL.

Dynamo and Motor Oil may be lighter, quicker acting oil than that used for engines. All modern electrical machines are fitted with ring oiling bearings, and are very economical in their use of oil, which should be one that will not drop in efficiency through continued use. Thickening of the oil in a bearing of this design will result in the ring being retarded and the flow of oil over the shaft being lessened.

GENERAL LUBRICATION OF HEAVY MACHINERY.

Openers, pickers, and cards are the heaviest and most important machines used in the ordinary manufacture of cotton or woolen goods. The best of care is used in setting up these machines, that they may be in perfect alignment, and all bearings true and to center. To keep the bearings in this condition attention to lubrication is absolutely necessary. Fires in picker rooms are also frequently caused by lack of attention to lubrication. Oils should be fed by cups or bottles to all bearings that are taking all the work of the machine, and should be heavy and somewhat quick in action. They should show clear in color after use.

Drawing frames should be treated with heavy lubricants. The top rolls require an especially heavy, greasy lubricant that will preserve a good wearing film for a considerable period. A compounded oil, an animal oil, or fat should not be used for top rolls, owing to the general tendency of these oils to oxidize and gum, thereby retarding the free movement of the roll, producing an uneven output.

GENERAL LUBRICATION OF LIGHT MACHINERY.

Under this head should be classed all intermediate machinery, general lubrication of spinning frames, loose pulleys, and the light finishing machinery. This oil may be of such a character that it can be used upon the spindles of speeder and intermediate frames. It should be an oil of low fluid friction, non-gumming, and one that will stay in place.

If every ounce is required of the engine, and the mill is to be worked to its highest efficiency, in connection with the oil for spindles of intermediate frames and speeders, one of lighter body may be used for the steps. Spindles are usually oiled once a day, steps once a week, or at a longer interval, so that two oils can be used with but little trouble.

Spoolers, winders, beamers, and slashers may be treated under the head of general lubrication of light machinery, and the same oils used upon everything in this class, excepting the

artificially heated bearings of slasher rolls, where the top roll oil should be used.

SHAFTING.

Shafting should be fitted with the best lubricant for the condition under which it operates. A certain horse power will be required to operate it under that condition. This horse power should be as low as good lubrication can make it, and it should be kept a constant by the use of new, uniform oil; any admixture of filtered oils from engines or machines, or any use of grease will increase the power necessary to drive that shafting. Compounded oils used upon shafting offer great resistance to the free operation of that item, and make the power a variable factor, which gradually increases as the deposits in the boxes become more pronounced, until the additional cost for power to operate the shafting beyond its normal point exceeds the extra cost of lubrication of this item with the most expensive oil to be had. Bearings of whatever description require ordinary attention to oiling, otherwise the oil will overflow. In textile mills tin guards or drip cans are usually provided, as a precautionary measure, to prevent oil from getting upon the goods in transit or process of manufacture.

Shafting hangers may be grouped as "open" and "ring oiling," and may be treated in three ways. Open boxes, if they are new, can be lubricated with a quick acting oil. In general character it should be adhesive, greasy, and as fluid as the condition will allow. Open shafting is sometimes fitted with bottles having spindles, which during the operation of the shafting cause the oil to flow slowly. If these bottles are carefully adjusted and an evenly constructed oil is used, an even condition is produced, but it is necessary to keep a uniform grade of oil supplied to the bottles after once adjusting them, and the oil should not contain a fixed material or leave any deposit, else the bottles, instead of being of service are quite the reverse.

Open shafting hangers that are badly worn and receive but little attention require a heavier oil, one that will act as a

cushion, stay where it is put, and prevent the hammering frequent in a worn box, and consequent loss of power by abrasion.

Ring oiling hangers should be oiled with a light bodied oil; one that will stand wear. The general characteristics for open work should also govern; that is, the oil should be greasy and should not leave a deposit, but the main point is that its initial efficiency must last. Where an open hanger is oiled at least every other day, a ring oiling hanger runs from one to six months. It is, therefore necessary to have an oil that will retain its original character so that the power to drive the shafting may be a constant throughout the period between the oilings.

LOOMS.

Outside of the spinning frame, no other class of machinery claims so much attention from the lubrication standpoint as looms. It is not power saving but "stainless" quality that is required of a loom oil. It is a generally acknowledged fact that no oil is stainless in the exact meaning of the word. In attempting to secure a stainless oil the power question is entirely lost sight of. The proper treatment of the subject should result in not only saving power, and in doing away with those effects a stainless oil is intended to overcome, but should also save the wear of the loom as well as the amount of oil used.

It must be borne in mind that all oils are dark colored to start with. A "stainless oil" or an oil that is white or nearly so, is manufactured by a bleaching or filtering process that takes out certain hydrocarbon qualities that are essential. This bleaching process leaves the oil rather characterless; it has nothing much to recommend it except its good appearance before using. It will turn black after use, carrying with it iron in solution, and iron in particles, evidences of lost power through abrasion; and it will damage any goods with which it comes in contact, the oil itself not causing so much trouble as the iron carried with it.

Compounding the bleached oil with an animal or fixed oil,

while holding up the body, brings another element into the problem, that of gumming, and deposit leaving, which acts against the power by presenting a poor lubricating surface to the lubricant. Straight animal oils should not be used owing to their tendency to oxidize.

In treating this subject, the natural condition of the present loom must be considered. The ordinary cotton loom cannot be compared at all with any other machine in a mill on a mechanical basis. It is always badly out of line, the boxes are always loose, the shafting is rough, the cranks roughly turned out of a forged bar, and the whole machine during operation pounds and shakes. However it meets the conditions for which it is built, can be built cheaply, and can be renewed at little cost when worn out or when improvements of parts makes its operation unprofitable. Upon this machine, instead of a light colored, light bodied oil that shows black after use, (a good indication that its lubricating power is very low) a greasy, heavy oil should be used; one having the essential characteristic of staying where it is put; not necessarily a stocky oil, but one of body. The color should not be considered. An oil of this character will stay in place, keep lubricated surfaces apart, prevent wear and the effect of wear. It will not drop or throw on to the goods, can be used in small quantities, and should reduce the power required to operate the loom by preventing actual metallic contact of the surfaces.

SPINDLES.

Spindle lubrication is probably the most important item in the mill and much has been written on this one subject from a practical standpoint. It was stated some years ago with the advent of the Rabbeth or bath type of spindle, that a so-called light gravity oil was the best to use for economizing power. After the subject had been widely discussed, there seems to have been no concerted action on the part of users of these spindles to arrive at a standard. Some go better than the light oil theory, and use an oil too light, working entirely from a gravity

standpoint, thinking that the lighter the oil the easier the spindle will operate. Black, worn spindles, and large renewal bills with a constant expenditure for power consumed by abrasion, is the usual result of such practice. An oil to be a good spindle lubricant must have other characteristics besides light gravity. It must be homeogeneous in character, that is, so constructed that it will not change in lubricating value from oiling to oiling; the power to drive spindles must not increase as the oil wears until just before the renewal of the oil it is taking a great deal more power than absolutely necessary. The oil must be strictly neutral, and absolute freedom from material that will gum and attack metal is necessary. Moisture in a spindle oil produces a brown rust; acid will produce rust and attack metal; gumming will greatly add to the power to drive spindles. Spindle oils that contain any of the fixed oils will leave a varnish like deposit over all of the running part of the spindle except the foot, and over bolster and in the base. This film causes loss of power by means of offering extra resistance to the revolving oil. A smooth, clean spindle and bolster with a dry, clear, quick oil are necessary in order to secure the best efficiency. The most power in spindle work is lost through the oil friction of the lubricant used. The oil should be of sufficient weight to keep the surfaces apart under the light pressure of band pull and load, and should work upon itself with the greatest ease. The construction of such an oil enters largely into the problem. One that is made by a destructive method of distillation, where the molecular parts are altered by burning, and where this charring and burning effect is partially removed by use of acids, will not work well upon itself. Every care should be exercised in the various stages of manufacture of a spindle oil, as it must run uniform in grade and quality. One bad barrel will effect the power of an entire room, and may cause endless annoyance, besides loss of production and power.

Bath spindle oil from an oil manufacturer's standpoint is a very small item. It is a small item to the mill when compared to the total lubrication bill. However, this oil should not be

overlooked, as there is no single class of machinery that is so quickly influenced and that responds so readily to lubrication or the lack of it as the modern spindle.

Spindles of the Sawyer or open type require a more stocky lubricant, as there is no mechanical method of retaining the lubricant upon and around spindle and bolster, other than the nature of the oil itself. In extremely fine cases it is possible to use two oils, one for the bolster and another for the steps. The latter may have the same characteristics as the bath spindle oil, but it will have to be applied more often.

Mule spindles, if new, may be treated the same as the lighter Sawyer or open spindles, by using two oils; one for the bolster and one for the steps, or one oil weighty enough for the bolsters may be used all around. If the spindles are worn badly as is the case in most old machines, the extra bolster oil is almost a necessity. It should be an oil about twice as heavy as that used for Sawyer spindles. This will effect a cushion, prevent abrasion and consequent loss of power. The initial power required to operate with the heavy oil will be greater, but there will be no loss caused by the surfaces coming together, as they eventually would if a light oil were used. If a mule is noisy, and produces a sharp dry rattle, this treatment will invariably show a decided and immediate improvement.

Twister spindles and heavier spindles of bath types should be treated the same as the regular bath spindles, if power is being considered. The only change, owing to the extra weight of the spindles would be to oil up more frequently; where this is not done an oil heavier in nature must be used.

TOP ROLLS.

Top rolls, as in drawing frames, whether solid or shell, should be oiled with a mineral, non-compounded oil, which should be the heaviest oil used in the mill, outside of cylinder work. It should be a stocky, greasy, mineral oil that will not flow readily so as to run out on the leather covering, or onto the yarn. While the speed is slow and the weight light, and the power, as compared

to the frame, small (probably eight per cent.) the drawing roll condition from a production standpoint is an important one, and a well lubricated condition is necessary to the smooth running of the work in the machine and during the after processes.

DYE HOUSE LUBRICATION.

The general lubricant for dye house machinery should be of a heavy character; the older and more worn the machinery, the heavier the oil. Shafting may be handled the same as any other shafting proposition, entirely upon the mechanical condition of hangers.

Washing machines and dryers come under general lubrication, except the artificially heated bearings, which require an extra stocky oil, in order that the working heat may not bring the body of oil below the machine requirements.

Cylinders of small individual engines running printing machines should be fitted with automatic lubricators, or where several engines are fed from a header the oil may be put into the steam in the header, and one lubricator will do for several cylinders. Owing to ordinary lack of attention given these small engines the engine oil should be heavy. The general lubricant may be used with satisfaction. Outside of shafting, all dye-house machinery may be classed and treated alike, excepting the dryers and machines working under artificial heat.

Woolen and worsted mill lubrication varies from cotton mill lubrication in the requirements of the spindles. Cap spindles should have an oil slightly heavier than open spindles in cotton mills. Mules can be treated the same. Where spinning and twisting is done with bath spindles a heavier oil is required than that used on the cotton spindle but it must have the same general characteristics.

The cost of oil should never be considered in selecting lubricants, since a reduction of seven per cent. in the total horse power of a mill through reduction of frictional losses will usually pay for the entire oil consumed. Three per cent. saved from the total horse power of a mill will more than offset any increase

in yearly cost from the very cheapest oils to the most expensive adapted lubricants. In many modern mills there is no investment which can be made for new machinery, or any improvement in system of operation, or reduction in cost of production which will give the immediate financial results that attention to lubrication from an engineering standpoint will produce.

The facts outlined in this paper have been obtained from many comparative tests under a new system of testing, but it is not within the scope of this present paper to enter into a treatise on comparative testing work, or to show the methods and system employed in operating upon single machines, or upon the entire mill to secure the effect of a reduction of frictional horse power.

The PRESIDENT. Gentlemen, you have heard this very interesting paper. Are there any questions to be asked Mr. PARISH?

Mr. GEORGE OTIS DRAPER. Mr. President, I notice that Mr. PARISH in his paper says: "Moisture in a spindle oil produces a brown rust." I am quite interested to know just what the nature of that moisture is. In several mills, in making power tests I have taken spindles apart and found the bases full of this very reddish sediment, and I never knew just what occasioned it. Mr. PARISH says it is moisture. Is that moisture in the nature of water, or is it an adulteration of the oil, or just what is it?

Mr. WILLIAM F. PARISH, Jr. More or less moisture gets into all oils during some of the processes of manufacture. Oils for some purposes are especially treated to make them absolutely dry. In storing barreled oils in mills or plants, where there is no regular established oil house, or where the barrels are allowed to remain in an exposed position, water will sometimes get on the barrel head and soak through. I have found boys carrying oil to the spinning room in pails which had previously been used

for carrying water, and it requires but a small percentage of water to effect a lubricating oil. This reddish sediment might also be caused by the acid used in preparing some oils. A heavier deposit is sometimes left by oils containing free paraffine. The effect of a poorly constructed oil is more noticeable where the oil is retained around the bearing, as in the case of a spindle base, and is not being constantly renewed.

Mr. THOMAS H. SMITH. Does oil absorb moisture from the atmosphere?

Mr. WILLIAM F. PARISH, Jr. Yes, but not to any great extent. We have found in mills where the tanks were kept under humidifiers, that the oil seemed to be affected more than where it was away from them.

Mr. JOHN E. PREST. Mr. President, I would like to ask Mr. PARISH what gravity and viscosity of oils he recommends to secure the best results, either for Rabbeth spindles or for what he calls the heavy machinery?

Mr. WILLIAM F. PARISH, Jr. In my paper, I said that gravity and viscosity did not indicate the value of the oil. Sometimes it is advisable to put in what we, from an engineering standpoint, would call a heavy oil, yet that heavy oil would be what the chemist or what you, from a gravity or a viscosity standpoint would call a light oil.

Mr. JOHN E. PREST. Let us confine ourselves to a Rabbeth spindle; what kind of oil is best adapted for that use? That is, a Rabbeth spindle or a self-contained spindle. We have 275,000 spindles, and a little loss on each one amounts to quite an item. I think all mills in the country have been working on that point to find what is the best oil to use that will give the best results as far as power is concerned and lubrication.

Mr. WILLIAM F. PARISH, Jr. I cannot tell you from a gravity standpoint what is the best oil to use.

Mr. JOHN E. PREST. Or from a viscosity?

Mr. WILLIAM F. PARISH, Jr. Or from a viscosity standponit. There are other characteristics that govern the value of an oil that we do not seem to have any way of telling you about. You will have to go back and find out how the oil is made. I might say that an oil of 35 degrees gravity would be the best for self-contained spindles, and you might get that oil and find that it was not the best. Yet I could probably give you an oil or you might secure another oil of 35 degrees gravity and find that it was exactly what you required.

Mr. JOHN E. PREST. For 35 degree oil what viscosity would you recommend or can you recommend any of any kind?

Mr. WILLIAM F. PARISH, Jr. We have standard oil that we use, of course. Each house has a standard oil, I suppose, that they think is the best to use for that class, but these oils do not give the same results. The gravity and the viscosity may be identical, and yet you will not find the same results upon the testing machine or upon the spinning frame, as I think you will find from a later paper which Mr. HARTSHORNE is to present.

Mr. JOHN E. PREST. I believe it is possible to lubricate with water.

Mr. WILLIAM F. PARISH, Jr. I understand so.

Mr. JOHN E. PREST. It was tried on some spindles some years ago from the Charles river in Waltham. The main thing, I suppose, is for the manufacturers to get some standard to work from. Of course we have all sorts of conditions, but as a rule, spindles are a standard thing throughout the country. One man says he wants a 35 gravity oil, another a 32, but he does not say anything about the viscosity — whether he wants it 95 or 200. What we want is to get some point for a standard that gives the best results.

Mr. WILLIAM F. PARISH, Jr. In a later paper I think that you will be partially answered in that respect.

The PRESIDENT. Are there any other questions to ask Mr.

PARISH? I would like to ask, Mr. PARISH, if you please,—on page 127 you have this division of the different classes of oil for different groups of machinery. Does it necessarily mean that each of those groups should have a different oil?

Mr. WILLIAM F. PARISH, Jr. I have treated the subject, with an idea of obtaining the very lowest frictional horse power that it is possible to get by using oil as a means of reducing friction. I find that it is necessary to group the machinery as I have it and use a practical oil for each group. Sometimes I am not allowed to use all the oils. I have to use one oil, for instance, for heavy or light machinery and treat some of the heaviest machinery as a special factor; in that case I cannot give as low a horse power reading. I have specified four oils for engine room work and two oils for mill work and an oil for shafting, a loom oil and a spindle oil. The lubricant for light machinery can be used on the open spindles if just ordinary service is required, but if special service is required and attention is being paid to the very small losses which can be reduced, it s advisable to group the machinery and use the oils as I have specified.

The PRESIDENT. As a matter of fact, Mr. PARISH, with a bearing of a given diameter, with a given pressure and given revolution, does it make any difference whether that bearing is on the shaft overhead or on the end of a machine?

Mr. WILLIAM F. PARISH, Jr. No difference, except as to the method in which the oil is fed.

The PRESIDENT. Bearings of a machine of the same type, I should have said.

Mr. WILLIAM F. PARISH, Jr. It would make no difference.

The PRESIDENT. In your paper, on page 134, you speak of a loom being such a bad machine. Did you ever have anything to do with the Draper loom? [Laughter.]

Mr. WILLIAM F. PARISH, Jr. Well, mechanically—I was speaking of looms in general—Mr. DRAPER'S looms, those

that I have been privileged to see, are a little better mechanically —that is, as to their bearings. I don't know whether they will do the work better or anything of that kind, but mechanically they are in better shape to lubricate than the ordinary cotton loom which I have found. I am not a cotton man or a weaver; I don't know much about these different appliances except from a mechanical basis.

The PRESIDENT. I thought perhaps out of justice to Mr. GEORGE OTIS DRAPER, who was here, it would be well for you to explain whether you made your experiments on a Draper loom or on some other loom. The loom which you had was evidently a very bad loom.

Mr. WILLIAM F. PARISH, Jr. No; this is the impression I have from about four years' work in different mills. I think that you will agree with me that a loom from a mechanical basis cannot be compared with anything else in a mill—on a strictly mechanical basis. That is, considering the point I have to deal with—the bearings from the lubricating standpoint. As I say, it meets the need for which it was designed and is a good producer.

The PRESIDENT. From this platform I should not want to discuss that particular question, but I think you will find that looms as a rule are well built and are mechanically, perhaps as well designed and constructed as any machine in a cotton mill. They do not require the absolute adjustment that some machines require, but with some types of looms the adjustment is as fine as it is on any machine in a cotton mill in order to give good results. I did not intend to bring this question up particularly, only I noticed that you made a reference to a loom as if it were a very bad sort of an animal and I was afraid you might have run into some of the Northrup looms. [Laughter.]

Mr. FRANK A. BOWEN. Mr. President, under the head of shafting, statement is made that the use of grease will increase the power necessary to drive that shafting. I think it is quite a

common practice among mills to use grease for lubricating shafting. I would like to inquire what per cent. a power is increased by the use of grease.

Mr. WILLIAM F. PARISH, Jr. I wish to reserve all test data that I have found for some subsequent papers which I trust to be able to prepare upon the same subject; but I might say in experiments which I have conducted upon shafting lubricated with grease, we have obtained a reduction as high as forty per cent., that is, taking the grease out and using oil,—taking our readings from motors. In the test I have in mind, should we have put back the grease, the power necessary to run the shafting, would have been increased 64 per cent. The grease I think referred to is the stick grease. I have other instance, where the shafting was lubricated with thirty-five per cent. grease—that is, thirty-five per cent. of the hangers were lubricated with grease. We took the grease off and put in oil and obtained about twenty-two per cent. reduction in power. I have many such tests on record and will prepare the data at a later date.

Mr. THOMAS H. SMITH. Can't you give us any ready method by which we can ascertain whether the oil for the Rabbeth spindle to which Mr. PREST has referred is doing its work or not?

Mr. WILLIAM F. PARISH, Jr. I think that will be answered in a subsequent paper by Mr. HARTSHORNE which comes immediately after mine. He had some very interesting tests along that line.

The PRESIDENT. Any further questions? This subject of lubrication is very interesting, and we might continue this discussion indefinitely. I have a great many questions in my own mind. But I do not think it is best to take up any more time unless some one has something particular to ask. If not, we will proceed to the reading of the next paper, Observations on Spindle Banding, by WILLIAM D. HARTSHORNE, a member of our Board of Government.

Mr. WILLIAM D. HARTSHORNE. I wish to call attention to the note at the bottom of the first page of this paper, showing the references to the subject of spindle banding, and I would say that if I had taken the opportunity to read all these papers before I began my article, I should probably either have not written it at all or have written it on somewhat different lines, as the subject has been already so thoroughly treated by other persons interested in the matter.

In this connection also, I wish to call attention to the fact that in the rooms of the Association in Boston there is a mine of information on many subjects, both mechanical and related to the materials used in manufacturing. Recently an elaborate card index has been prepared by our secretary, so that any one who wishes to get information on a particular subject can easily find it.

*OBSERVATIONS ON SPINDLE BANDING.—A PLEA FOR SOMETHING BETTER.

WILLIAM D. HARTSHORNE, Lawrence, Mass.

AS AFFECTING LUBRICATION.

In a treatise on "Friction and Lost Work in Machinery and Mill Work," by Dr. ROBERT H. THURSTON, published by John Wiley & Sons, 1898, page 101, I find this paragraph:

"A perfectly lubricated bearing should follow the laws of fluid friction, and its friction should be independent of the intensity of pressure produced by the load, varying as the square of the speed of rubbing. Such perfect lubrication has never yet been attained."

In just so far as it can be attained, the necessity for something better in the way of banding, or some better method of driving the spindles on a spinning frame will be less evident. Laboratory experiments have brought to light a great deal of information as to the kind of oil likely to be best for a specific purpose, but experience in actual practice shows that the final arbiter must be careful experiment in that practice itself.

In view of just such an idea of the possibilities of more per-

* For other papers on the subject of Spindle Banding reference is made to the Transactions of the Association in papers by WILLIAM P. HAYES, volume 13, page 15; EDWARD ATKINSON, volume 25, page 14; C. J. H. WOODBURY, volume 26, page 41; GEORGE DRAPER, volume 26, page 51; C. J. H. WOODBURY, volume 28, page 62; CHANNING WHITTAKER, volume 38, pages 111 and 156; EDWARD ATKINSON, volume 38, page 110; C. J. H. WOODBURY, volume 38, page 111; FRED LACEY, volume 65, page 144; ALFRED E. ADAMS, volume 62, pages 292 and 248 GEORGE OTIS DRAPER, volume 63, pages 175 and 208.

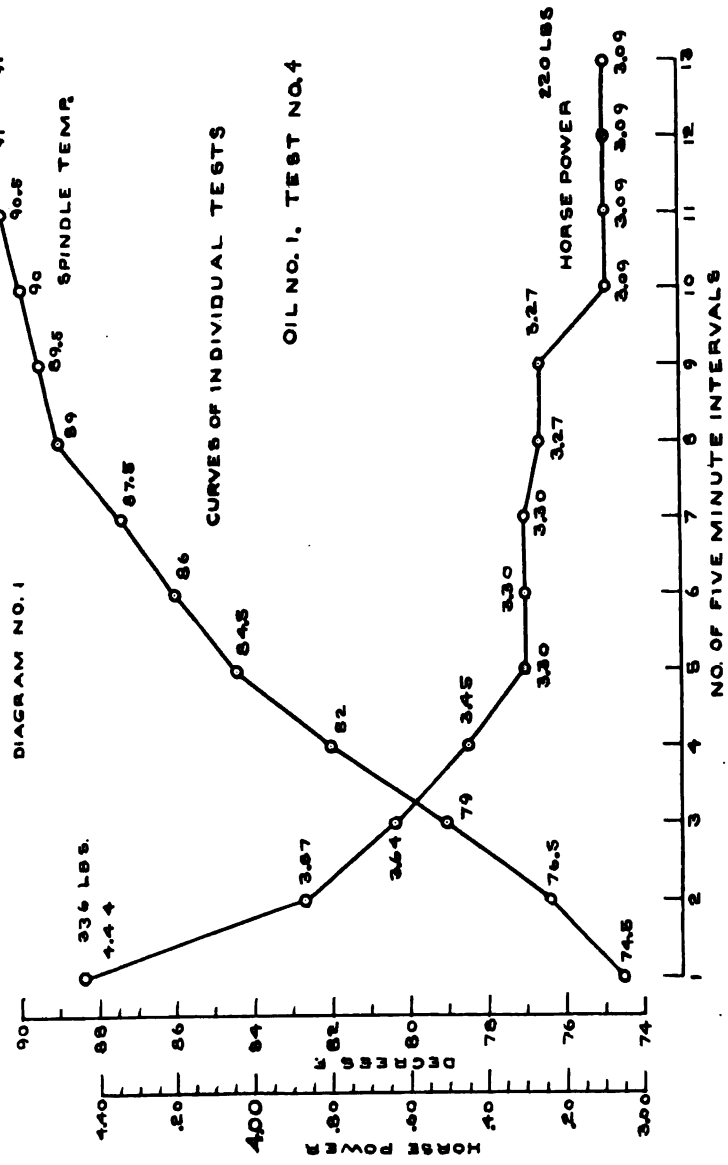


DIAGRAM NO. 1
CURVES OF INDIVIDUAL TESTS
OIL NO. 1. TEST NO. 4
SPINDLE TEMP.
HORSE POWER
220 LBS.
336 LBS.
4.44
3.87
3.64
3.45
3.30
3.30
3.30
3.27
3.27
3.09
3.09
3.09
91
91
90.5
90
89.5
89
87.5
86
84.5
82
79
76.5
74.5
HORSE POWERS
DEGREES F.
NO. OF FIVE MINUTE INTERVALS

fect lubrication, and for the purpose of determining if practicable the comparative advantages in a series of spindle oils, twelve in number, experiments were made at the Arlington Mills, Lawrence, Mass., during a considerable period of 1901 and 1902. In the course of these experiments it became very plain that more information was needed as to the exact effect of the "side pull", as it is frequently called, of the band, and the effect of the temperature of the spindle itself as interdependent factors in determining the comparative usefulness of different oils.

The frame upon which these experiments were tried was a 184-spindle Fales & Jenks twister, using the Rabbeth-Sherman spindle — speed about 6,400, size of whorl 1¼ inches — driven by a common hook band. The power scale used was the ordinary Emerson cotton mill scale for 1¼-inch shafting. To eliminate the element of drag caused by the twisting process these tests were made upon the bare spindle. For the purpose of confining the element of power required as closely as possible to the spindle itself, all the driven parts, gearing, rolls, etc., were disconnected, and the power required to run the cylinder, with the bands entirely off, but under otherwise careful lubrication was first determined, and in all subsequent experiments this quantity (.35 horse power) was assumed to be constant, and deducted from the total power required to run the bare spindles and cylinder together. The resulting power thus obtained was assumed to be that due to the running of the bare spindles alone, under the varying conditions of band pull and temperature which were observed. It was found to take up so much time, however, to determine the actual band pull before and after each test that only one-half the number of spindles were actually tested for band pull, and the total for the frame was assumed to be twice this one-half so actually determined. By several tests, not here recorded, this appeared to be a practically correct basis.

It was at once apparent in making these tests that there was almost invariably a large difference in the amount of band pull between the beginning and end of a test covering a period of

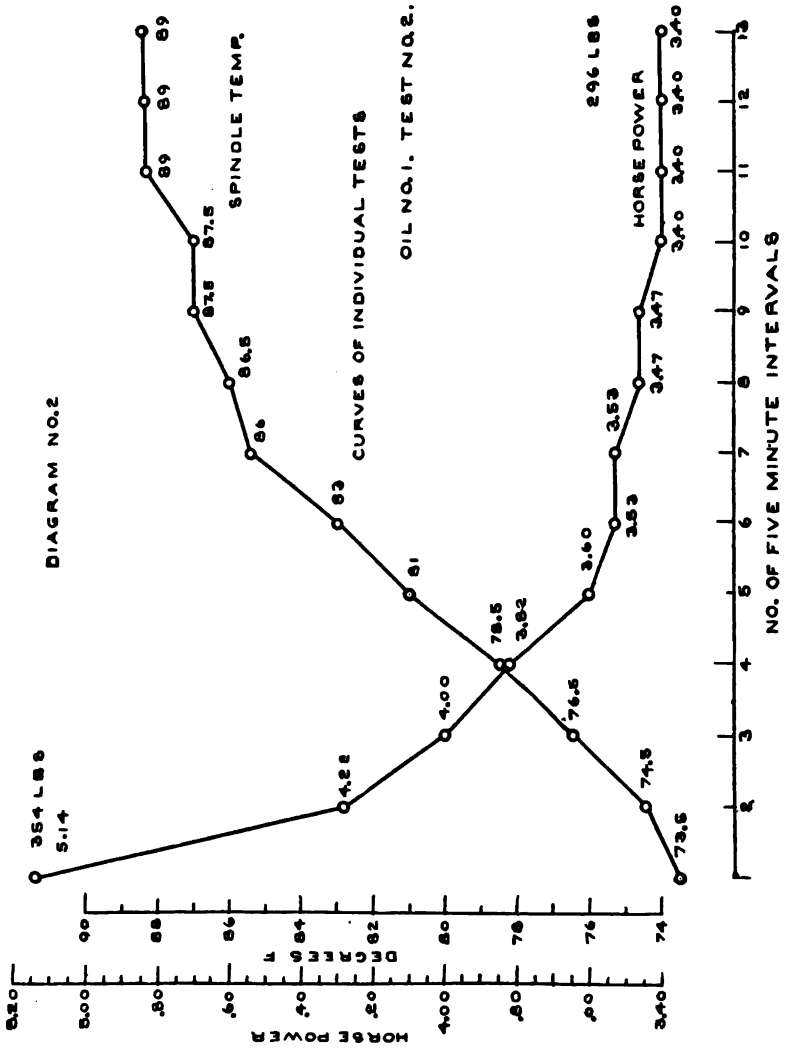


DIAGRAM NO.2
CURVES OF INDIVIDUAL TESTS
OIL NO.1. TEST NO.2.
354 LBS
5.14
296 LBS
SPINDLE TEMP.
HORSE POWER
DEGREES F
HORSE POWER
NO. OF FIVE MINUTE INTERVALS
89 89 89
87.5 87.5
86.5
86
83
81
78.5
76.5
74.5
73.5
4.28
4.00
3.82
3.60
3.53
3.47 3.47
3.40 3.40 3.40
90
88
86
84
82
80
78
76
74
5.20
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
2 3 4 5 6 7 8 9 10 11 12 13

about one hour; during which period a record was kept at five minute intervals of the temperature of the spindle base of a single spindle, the same spindle being used throughout all the tests, and also of the power consumed by the running of the empty spindles on the above indicated basis. As typical of a single set of observations, diagram No. 1 is shown. This is on test No. 4, on oil No. 1. On this diagram the total band pull (meaning thereby the sum of the band pulls of 92 spindles multiplied by 2) is shown at the beginning and end of the test.

In comparison with diagram No. 1 we show diagram No. 2, test No. 2, for the purpose of showing the difference which was found to exist on the same oil under different conditions. For the purpose, however, of arriving at some definite basis of comparison between different oils, an effort was made to eliminate these varying conditions of individual tests by taking the average of five tests on each oil, and:

Diagram No. 3 represents the average of five tests for oil No. 1.
" " 4 " " " " " 3.
" " 5 " " " " " 12.

The average band pull at the start and finish being also shown.

It is evident by these diagrams that the horse power may be affected by both the band pull and the temperature of the spindle. In fact this is a well known proposition, but just how much effect is to be attributed to the temperature and how much to the band pull these tests do not show. Omitting for the present the consideration of this feature, which under the circumstances was undeterminable, and considering only the initial and final tests where only the band pull was determined, we give the following table, No. 1, showing the total band pull, the horse power per pound of band pull, spindles per horse power, the observed temperature of the spindle for the start and finish of each series of tests, and the averages of the five tests for each of the twelve oils, except that oil No. 9 shows but one test, as an accident happened to the power scale which prevented the re-

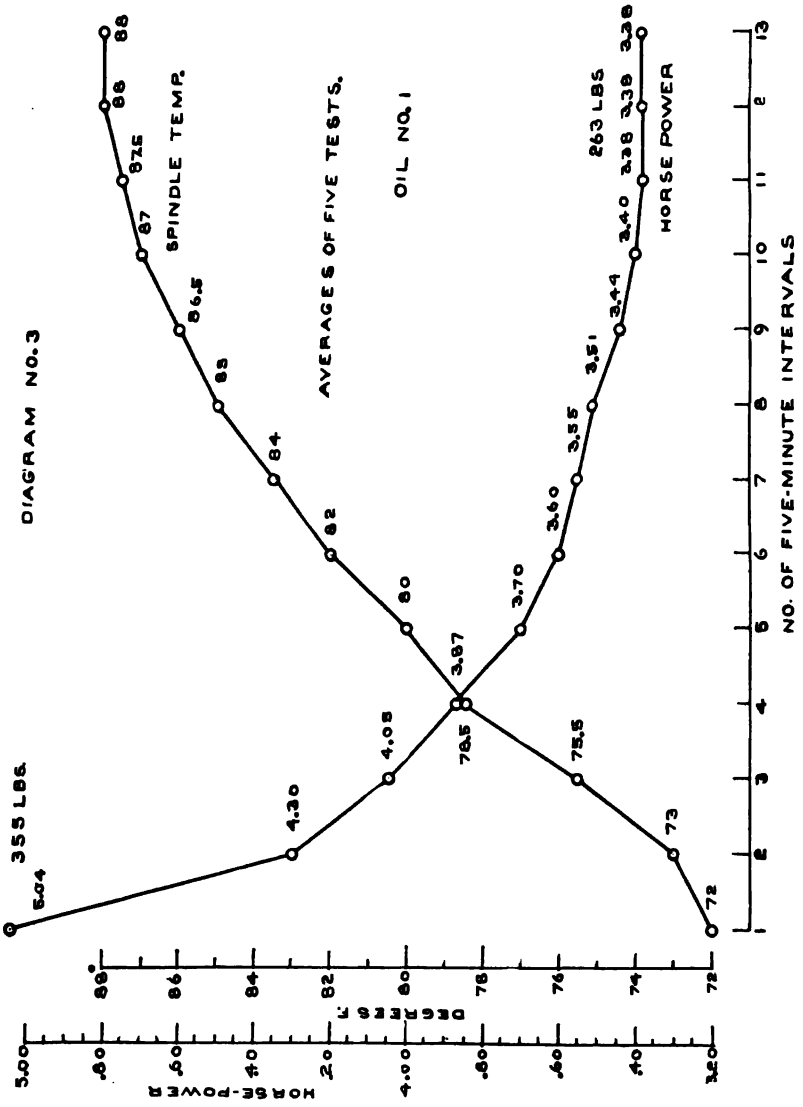


DIAGRAM NO. 3
AVERAGES OF FIVE TESTS.
OIL NO. 1
SPINDLE TEMP.
HORSE POWER
355 LBS.
263 LBS.
NO. OF FIVE-MINUTE INTERVALS
DEGREES F.
HORSE-POWER
5.04
4.30
4.05
3.87
3.70
3.60
3.55
3.51
3.44
3.40
3.38
3.38
3.38
88
88
87.5
87
86.5
86
84
82
80
78.5
75.5
73
72

maining tests being considered reliable, and they were, therefore, thrown out.

It is evident from this table that in spite of the fact that we have two variables to consider, namely, band pull and temperature, as related to the horse power, certain facts are in a measure determinable. To illustrate them we present the following diagrams:

Diagram No. 6 shows the average total band pull at the start and finish of the tests for each of the twelve oils.*

It is manifest from this diagram that the band pull varied tremendously between the beginning and end of each test — that it also varied greatly between one test and another during the interval of time over which the tests were extended. How far this difference of band pull was due to atmospheric conditions alone these tests do not show. At the time they were made the determination of this factor was not under consideration. Apparently, however, there are two elements involved: that of change due to atmospheric condition and that due to recovery of elastic tension from the standing of the spindle. It is a well known fact that in the starting up of a mill after standing even for one hour, there is a corresponding tightening of the bands and increase of load. How these are related to each other and the element of temperature involved, we will endeavor to show by some later observations.

Diagram No. 7 shows the average horse power per pound of average band pull for each of the twelve oils at the start and finish of the several tests. This method of comparison was made with the idea that it might eliminate the question of variation in band pull, and enable us to determine the relative value of the oils independent of that variation, and at the same time show how efficiency was dependent upon temperature.

Diagram No. 8 shows the average spindles per horse power

* The oils are numbered in the order in which the tests were made, No. 1 being the oil heretofore used, and with which all the others were to be compared. The charts were made with the oils arranged in series according to specific gravity, No. 10 being the lightest, and No. 2 the heaviest of the series.

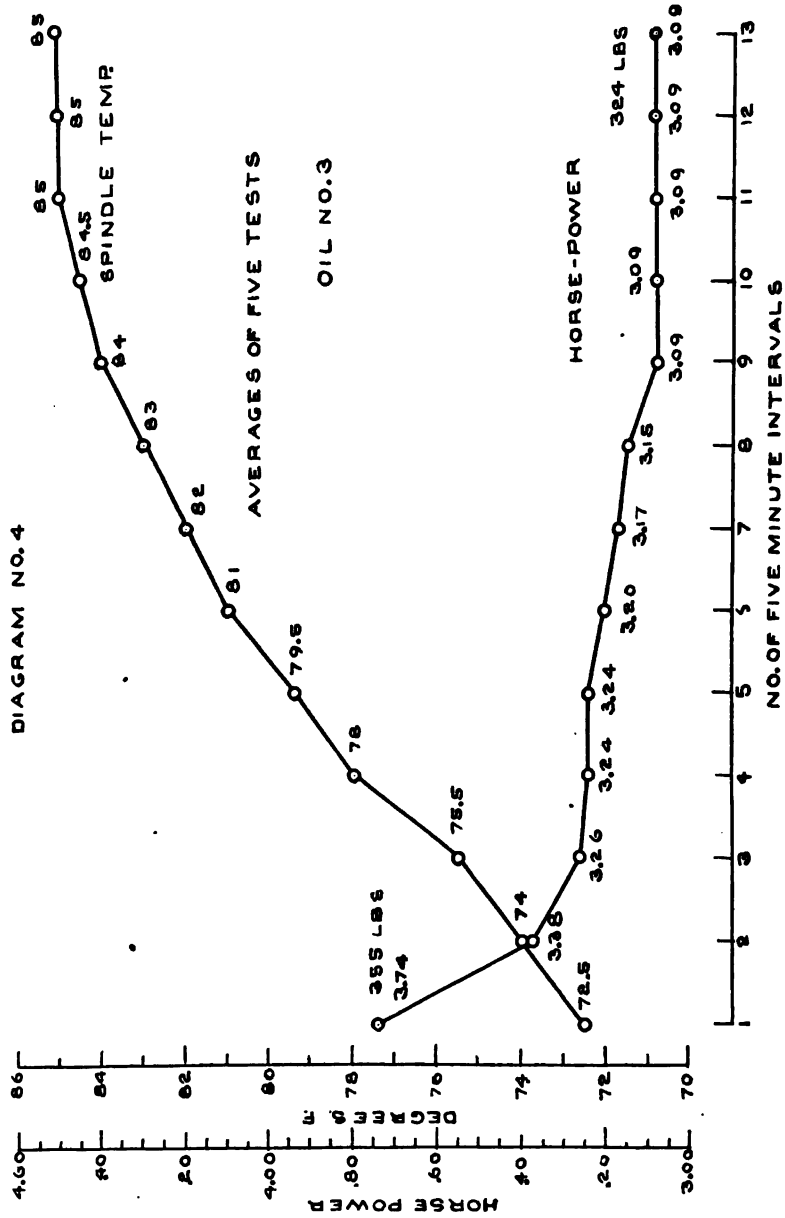


DIAGRAM NO. 4
AVERAGES OF FIVE TESTS
OIL NO. 3
SPINDLE TEMP.
HORSE-POWER
355 LBS
324 LBS
NO. OF FIVE MINUTE INTERVALS
DEGREES F.
HORSE POWER

for each oil, corresponding to the same data as above. On this diagram is shown also the average temperature at the start and finish.

If we consider diagram No. 8, oil No. 1, for the conditions at the start of the operation, shows poorer results than any except three (10, 11 and 12), but at the finish, after running for about an hour, which would be more nearly the normal state, it was better than all except Nos, 2 and 3. Is this last comparison the correct basis, and sufficient to determine the relative usefulness of this oil?

Referring to diagram No. 7, where we consider the horse power per pound of band pull at the start and finish, it would appear that at the starting point of the experiments oil No. 1 shows results better than 10, 11, 12, 6 and 9, and poorer than 4, 3, 5, 7, 8 and 2, while at the finish it stands better that 10, 11, 6, 7 and 9; Nos. 7 and 12 having changed places in order of rank, as compared with No. 1.

In both diagrams oil No. 3 shows up to be the best oil of all, with the exception of No. 2 it is so in such a marked degree that we think there would be no mistake in considering this as the best oil of the twelve for the purpose under consideration, and No. 2 as the next best. Would we be justified in considering the relative values of the other oils as accurately deducible from either of these diagrams?

On examination of diagram No. 7, oils Nos. 10, 11 and 9, the remarkable circumstance is to be noted that the horse power per pound of band pull is greater at the finish of the test than it was at the start, and also that the spindles per horse power for the same oils indicate a poor result both at the start and at the finish. At this point as a matter of record for information as to the characteristics of these twelve oils, we append diagrams Nos. 9 and 10.

It will be seen by diagram No. 9 that both the viscosity and specific gravity of Nos. 4, 10 and 11 are very low, but not so very much lower than No. 3. No. 3 has shown the best results both at the start and at the finish, that is, at the lower and at

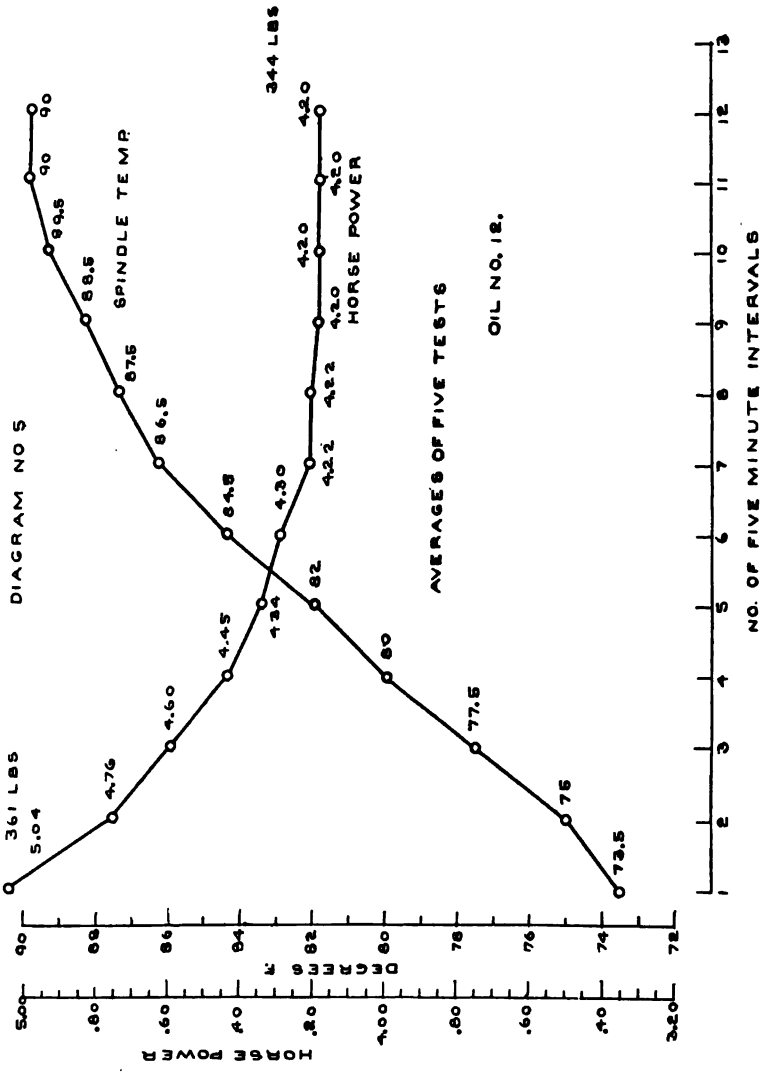


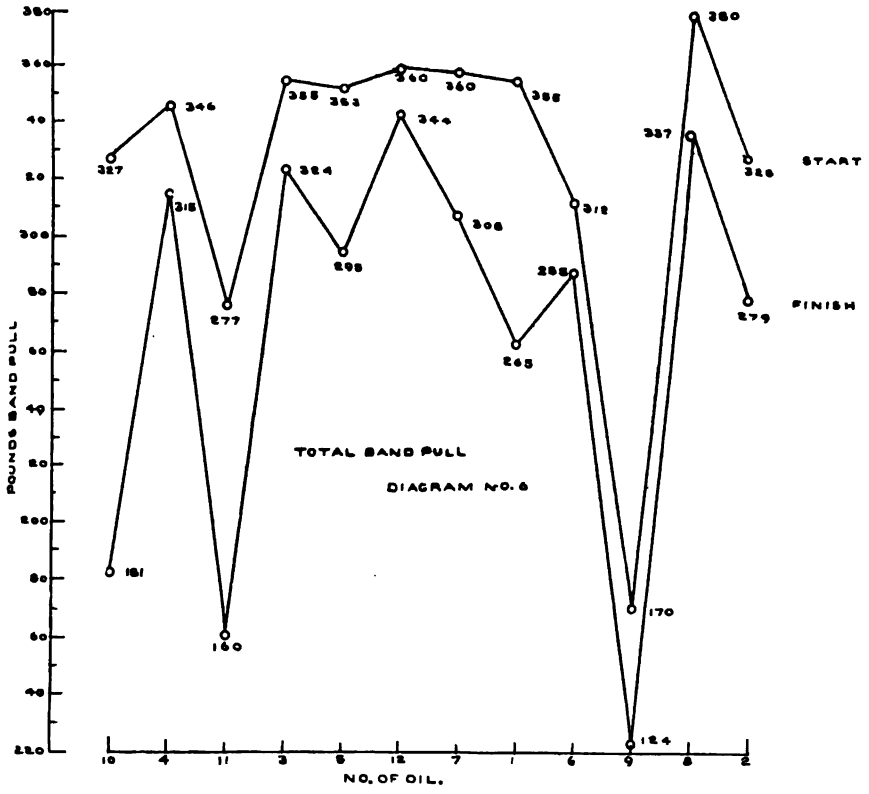
DIAGRAM NO 5
AVERAGES OF FIVE TESTS
OIL NO. 12.
361 LBS
344 LBS
SPINDLE TEMP
HORSE POWER
DEGREES F
HORSE POWER
NO. OF FIVE MINUTE INTERVALS
5.04
4.74
4.60
4.45
4.34
4.30
4.22
4.22
4.20
4.20
4.20
4.20
4.20
90
90
89.5
88.5
87.5
86.5
84.8
82
80
77.5
76
73.5
90
88
86
84
82
80
78
76
74
72
5.00
.80
.60
.40
4.20
4.00
.80
.60
.40
3.20
1
2
3
4
5
6
7
8
9
10
11
12
13

the higher temperature, whether reckoned by the spindles per horse power or the horse power per pound of band pull. No. 4 has shown fairly good results, though not as good as No. 3, while Nos. 10 and 11 have given apparently the poorest results of any of the four oils in question. Moreover, although there is on Nos. 10 and 11, as in general, a diminution of the total power consumed by the frame at the end of the operation over what it was at the beginning, that is to say, although the total number of spindles per horse power on Nos. 10 and 11 had increased during the test, this diminution of power would appear to have depended chiefly upon reduction in band pull, while the effect due to rise in temperature was either inconsiderable or negative in result.

Moreover, Nos. 9 and 2 are both relatively heavy oils, No. 2 the heaviest of the series, and in comparison with Nos. 10, 4, 11 and 3 both are more viscous at 70° F. Now No. 9 shows both a poorer result than No. 2 in spindles per horse power and the poorest of all the oils in horse power per pound of band pull (very low total band pull — see later comments), while No. 2 is next in efficiency to No. 3, both in spindles per horse power and horse power per pound of band pull for the band pull and temperature tried at.

It would appear, therefore, that some other property than is usually included in the terms "gravity" and "viscosity" had to do with the inefficiency of the three oils, Nos. 10, 11 and 9, or, to state it in opposite terms, with the greater efficiency of Nos. 3 and 2.

The particular spindles here under consideration were large and heavy compared with a spinning spindle. Their speed was relatively low, perhaps in actual speed not exceeding 6,000, the conditions are, therefore, quite different from a light spinning spindle of high speed. It so happens, however, that the average band pull per spindle during tests on Nos. 10, 11 and 9, both at the start and at the finish, compares on the low side with what is considered good practice on a spinning spindle — No. 9 indeed is quite low. It cannot be said, therefore, that

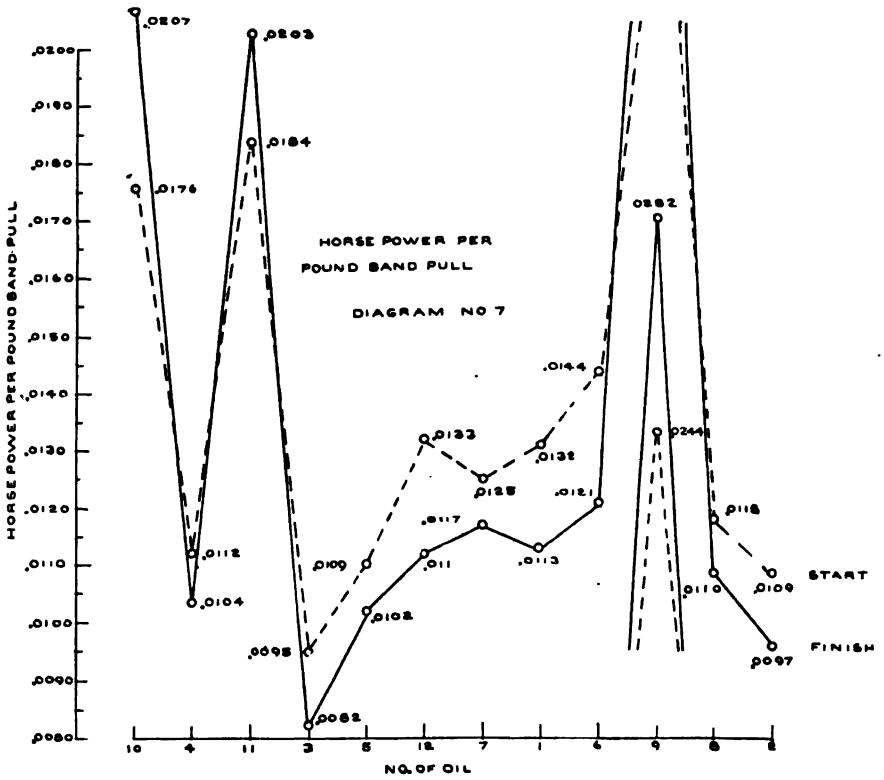

POUNDS SAND PULL
NO. OF OIL.
TOTAL SAND PULL
DIAGRAM No. 6
START
FINISH
327
346
315
277
160
355
353
360
360
355
312
285
265
344
306
294
284
181
170
124
337
350
329
279
10
4
11
3
5
12
7
1
6
9
8
2

the inefficiency of Nos. 10, 11 and 9 was due to any excessive band pull. There is, however, an ambiguity arising from the unknown precise relationship of variation in temperature and horse power per pound of band pull to the total band pull in all of these tests, which ought to be eliminated before one would be justified in setting any precise relationship between them. We cannot compare accurately two oils tested under different conditions of band pull or different conditions of temperature.

LATER OBSERVATIONS. — BAND PULL AND TEMPERATURE CHANGES.

As a further illustration of the rapidity of change, both in band tension and temperature, and the consequent change in load, the following tabulated statement (table No. 2) is given. This test was made on Sept. 5th of this year, on an old Whitin spinning frame of 272 spindles, running the bare spindles, with all other running gear thrown out. The band pull tests were made on 25 successive spindles on the same side of the frame, at the periods of time indicated in the table. The time of taking the band tension occupied just five minutes, and the stoppage of the frame was just five minutes for the purpose. The table also shows the temperature of the surrounding air in the room, the relative humidity and the spindle temperature for one and the same spindle throughout the test. Also spindles per horse power at the beginning and end of the test.

Diagram No. 13. The dotted line shows the total band pull of the 25 spindles at each of the intervals chosen. The upper disconnected line shows the change in horse power from interval to interval, as given in the table, and the marked effect of the stoppage of the frame for only five minutes at a time upon this horse power. The temperature curve is the temperature of the spindle base for the one spindle upon which observations were made. It is not quite apparent from the diagram and table how much effect the stoppage had upon the temperature, not absolutely lowering it even, so far as the external thermometer could show, until late in the test. Yet, the rate of rise was

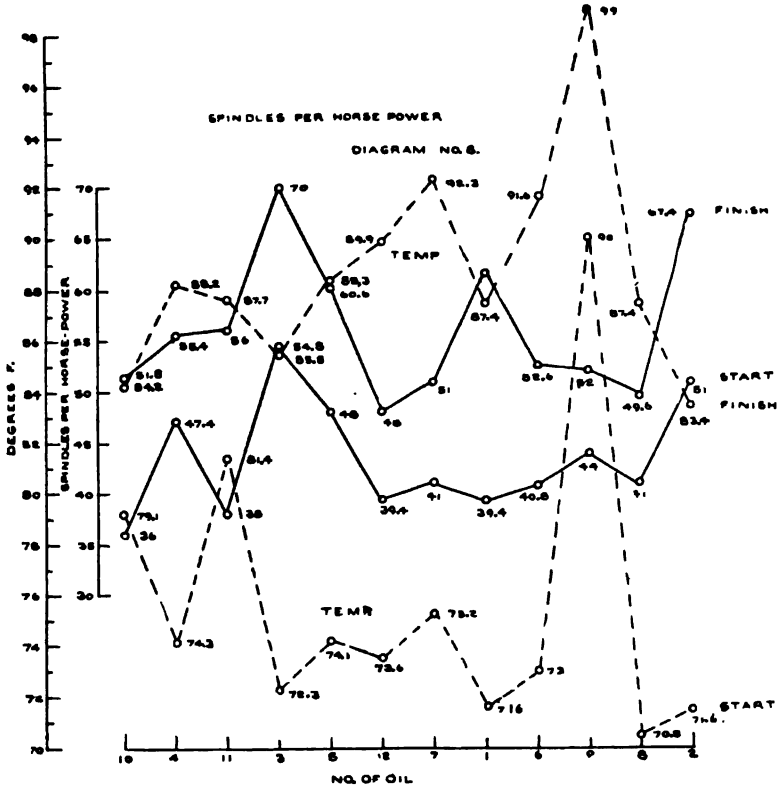

HORSE POWER PER POUND BAND PULL
DIAGRAM NO 7
HORSE POWER PER POUND BAND PULL
NO. OF OIL
START
FINISH
10
4
11
3
5
12
7
1
6
9
8
2

diminished during the stoppage period.* After the temperature had reached 91½ degrees, the five minute stoppage caused a drop of one-half a degree, and the same drop of one-half a degree took place at the next and last period of stopping. These observations were continued up to the time when the spindle temperature had become constant.

It will be noted that the horse power and temperature had become constant after the observation of 4.30 P. M., but the stoppage at 4.50 of five minutes immediately dropped the temperature one-half a degree and increased the horse power from 2.34 to 2.64, recovering to temperature of 92½ degrees and load of 2.34 in a five minute interval, and these were found to be at the same points twenty-five minutes later. It will be noted that although there was some change in relative humidity through this test it was not of a very marked amount, and its effect upon the band pull is not traceable with certainty, although it would appear that there was a slight increase of tension between 3.55 and 4.15. As a matter of fact, a shower occurred at just this time, but its effect as shown by the hygrometer does not appear to have reached the inside of the mill for some little time, and it could hardly be supposed that the bands were affected quicker than the hygrometer. In other words, the variation shown in the band tension is only such as would be easily accounted for by the insufficient delicacy of the apparatus.

It might be noted that these individual band pull tests were taken by the same person, and recorded by an independent person, so that the one taking the test did not know what the same band had registered at the preceding test. It will be observed that there was a fair degree of uniformity of result, generally varying consistently with what might be expected.

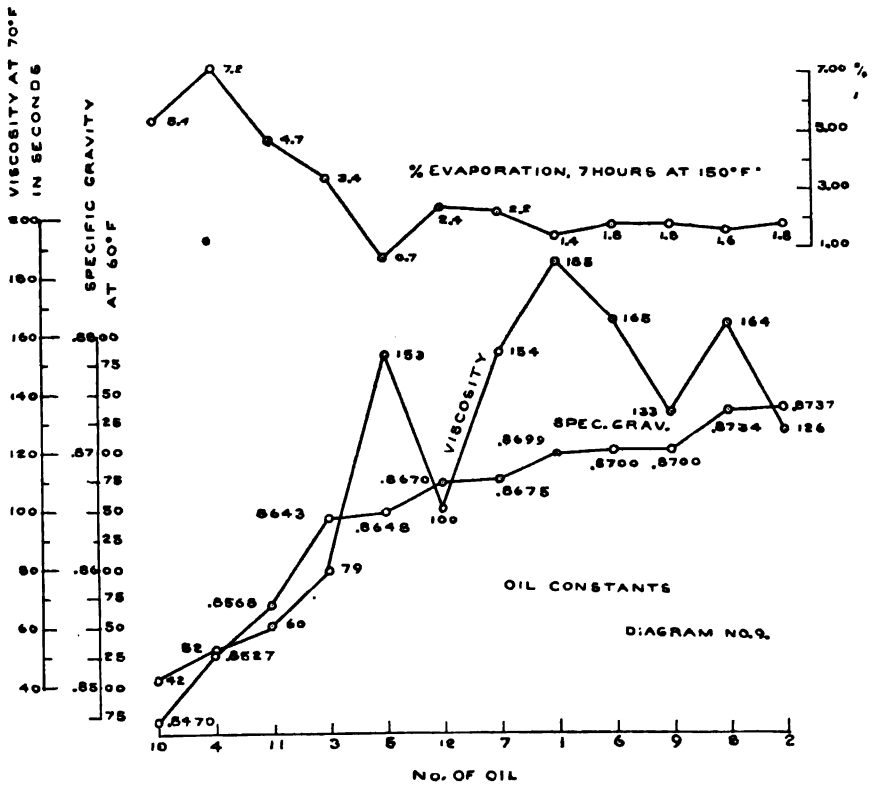
* It would seem that the apparent continued rise in temperature during the first stoppage period must have been due to the fact that the temperature at the end of the first five minutes within the spindle case must have been considerably higher than could be registered in so short a time by the exterior thermometer, and the heat had continued to be conducted out to the thermometer through the first stoppage period.


SPINDLES PER HORSE POWER
DIAGRAM NO. 8.
DEGREES F.
SPINDLES PER HORSE-POWER
TEMP
TEMP
FINISH
START
FINISH
START
NO. OF OIL
10
4
11
3
8
12
7
1
6
9
5
2

THE PROBLEM STATED.

Were it possible to produce conditions where the band pull was an absolutely definite constant amount it would be easy to determine what was the least amount of band pull consistent with uniformity of twist, for each kind of frame, whether spinning or twisting, and also what oil would show the most efficient results at that band pull for the temperature best suited to the health of the operative and the spinning or twisting properties of the material operated upon. As related also to the general features of power consumption the present variability of band pull and the effect of changes in temperature, are undoubtedly serious matters for the mill man's consideration. There have been many articles written upon the subject and published in the Transactions of this Association. Among these a very valuable paper may be found in Transactions No. 63, by Mr. GEORGE OTIS DRAPER. Beginning on page 175, I make this quotation:

"The band pull appears to be an easy problem, but in reality is very difficult of solution. Bands are made of pliable yarn or roving which is capable of great stretch, and constantly affected by changes in humidity. Not only are they affected by moisture in the air, but they also absorb oil thrown out by the spindles, and are liable to considerable contraction merely from resting between periods of work. When a frame is started up in the morning it can easily consume over 10 per cent. more power than when the bands have stretched by a few hours' running. A slight rain storm can also put the power up over 10 per cent. during the day. The boys who tie on the bands are rarely held accountable for getting them too tight, and the incentive is always in the wrong direction, as they are responsible for any troubles arising from slack bands. . . . . The prevention of a little slack yarn is often accomplished at the cost of tons of coal and years of wear. The general evils of the banding system can probably only be cured by an entirely new method of application or new construction of the bands themselves."


VISCOSITY AT 70°F IN SECONDS
SPECIFIC GRAVITY AT 60°F
% EVAPORATION, 7 HOURS AT 150°F.
VISCOSITY
SPEC. GRAV.
OIL CONSTANTS
DIAGRAM NO. 9.
No. OF OIL
10 4 11 3 5 12 7 1 6 9 8 2
8.4 7.2 4.7 3.4 0.7 2.4 2.2 1.4 1.8 1.8 1.6 1.8
7.00 % 5.00 3.00 1.00
.8470 .8527 .8568 .8643 .8648 .8670 .8675 .8699 .8700 .8700 .8734 .8737
82 60 79 153 100 154 185 165 133 164 126

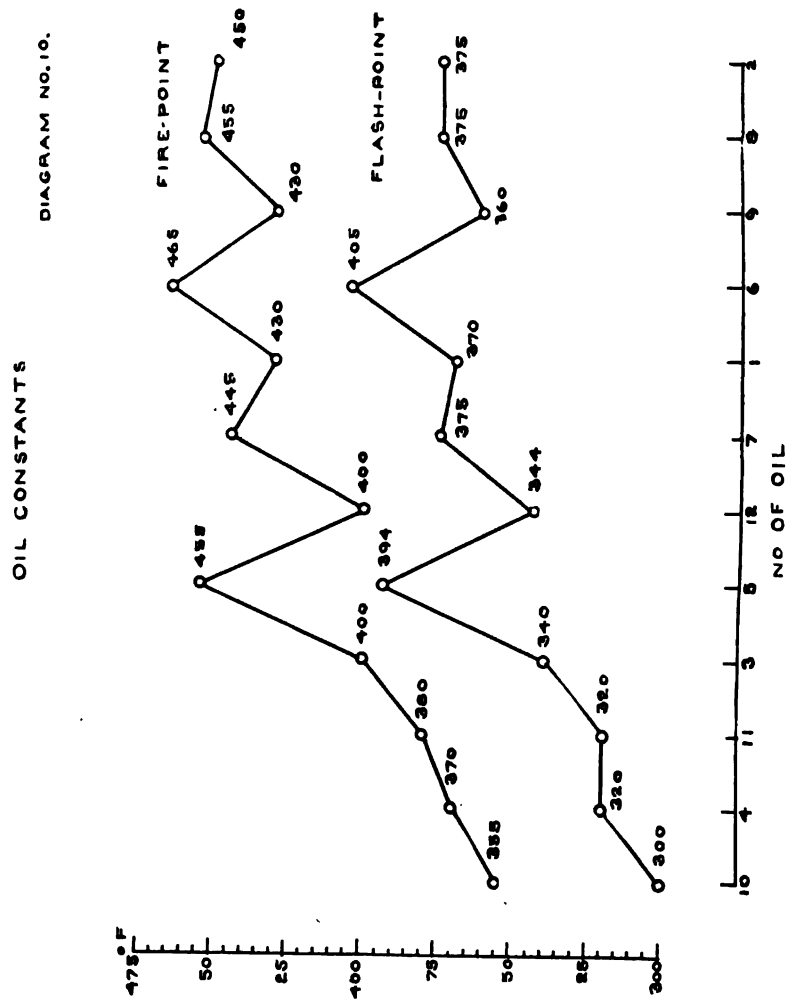
SOMETHING BETTER.

For many years in the worsted industry the use of either the loop band or the hook band for spinning frames has been largely done away with; the weighted tape band, one band driving four spindles, taking its place. This method has been applied to both spinning and twisting frames, whether cap, flyer or ring. The uniformity of load thus produced is certainly a great improvemcnt, and on heavy twisting frames particularly a greater uniformity of twist is certainly obtained, unless the hook or loop bands are kept at an excessive tension. Until quite recently, however, the writer has not had the opportunity of testing a Rabbeth spindle so driven. The ordinary cap frame using a tube on stationary spindle could not be well compared with a Rabbeth spindle on a test for power consumed by different methods of banding.

So far as the writer knows, the Rabbeth spindle ring twisting frames made in this country have been only driven with loop or hook bands, following the general custom in the cotton business.

The ordinary loop band, of course, everybody knows about. The hook band is similar in character, but instead of being joined together by a knot is joined by a little E-shaped hook, much like a small belt hook. That has been the band in use in the worsted industry ever since I have known anything about it. It has never been used much in cotton mills as far as I know. I have recently induced our own cotton mill to try these bands made in this manner on their twisting frames, and with very marked improvement in the quality of results and in the lessening of cost both of the bands and in the labor of putting them on. It is impossible — I should not say it is impossible because it may be possible to tighten the band by putting a little twist into it before you put it on; but otherwise the band, if it is the right length to start with, will be right when it is put on until it changes from its natural condition.

This method of tape banding may be illustrated by diagram No. 11, which shows in plan and elevation the arrangement


OIL CONSTANTS
DIAGRAM NO. 10.
FIRE-POINT
FLASH-POINT
NO OF OIL
°F
475
400
300
455
430
445
400
400
360
370
355
394
344
340
320
320
300
405
370
375
375
375
375
460

of the tape band taking care of four spindles. Owing to the delay in securing a large enough power scale of sufficient delicacy and accuracy, the writer has been unable to secure as much information from this style of frame as would be necessary to formulate many definite conclusions, but the possibilities of so doing are apparent from table No. 3, here given. These power weighings were made on a most excellent Emerson machine for 1¼ inch shaft, loaned through the courtesy of Mr. WILLIAM F. PARISH, Jr.

The first column gives the weight applied to the band by an equal armed bell crank lever, as shown in Diagram No. 11. The second column gives the speed of the drum. The third column shows the total horse power for the 200 empty spindles in the frame. These spindles were of the Rabbeth type made in England, differing slightly from the Rabbeth spindle made in this country. Samples of each of the spindles referred to in these tests are here on exhibition. Also samples of the kind of bands used.

The fifth column shows what might still be called horse power per pound of band pull, although such band pull may not be exactly comparable with the band pull as determined by the band pull tester on the ordinary loop band, but is the positive weight applied to the flat tape band itself.

The readings here given were obtained after the periods when the spindles had reached a constant condition as to temperature and horse power. Only two are shown, although a considerable number were made, all giving exactly the same figures. It is fortunate for the purposes of comparison that the temperature of the spindle base was so continuously constant throughout the tests. This eliminates the question of temperature variation while comparing the effect of different band tensions. Diagram No. 12 shows graphically the relationship of the total horse power and horse power per pound of band pull to the band tension element.*

* In the article by Mr. GEORGE O. DRAPER, hereinbefore referred to, we find on page 208 a table given to show the increase in power for each pound of band tension

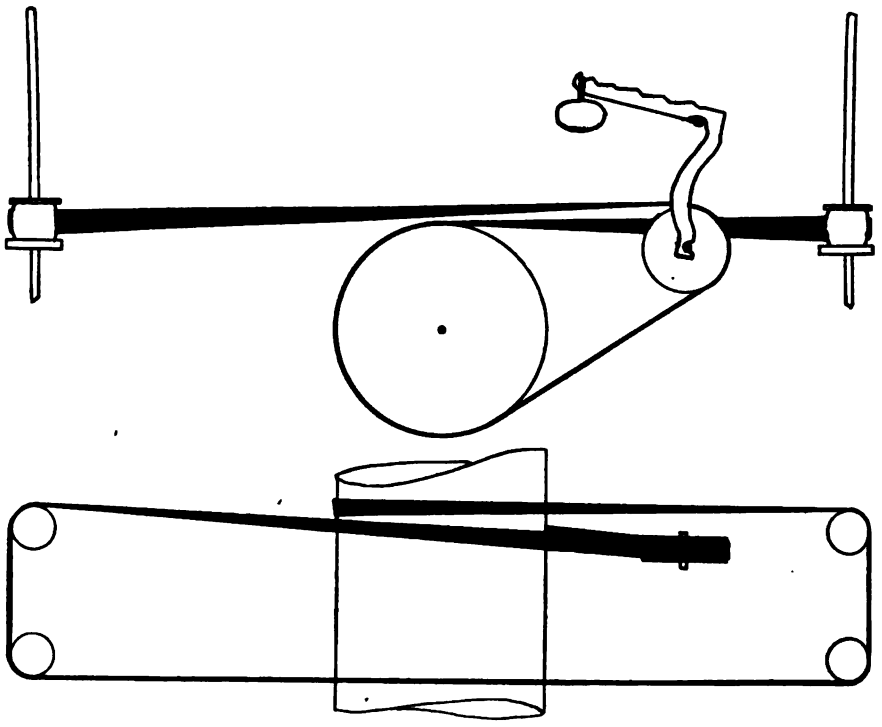


DIAGRAM NO. 11

Band Tension Regulator.

It is very interesting to notice that the effect of band tension on the load, when the temperature question is eliminated, is not in simple proportion to band tension. Upon reaching that point in the curve corresponding to the 3½ pound weight, the one which is normally used for working purposes on the frame, a further increase of such weight shows a change in curvature; from having been concave downward it now becomes concave upward. It would be extremely interesting to try this same test at the same temperature on the whole series of oils formerly experimented with, but there was not time to do this before the conclusion of this paper.

---

for different speeds and sizes of band on a *spinning* spindle. That is, it purports to confirm the statement at the top of this same page that "the ratio of power consumption to band tension is found to be uniform enough so that a scale may be figured sufficiently near for ordinary practice on usual spindles. When larger size spindles, such as are used for coarse yarn or twisting, are used a different scale would be necessary." The author states that his figures are derived from actual tests, but he does not describe them, and such figures seem to be inconsistent with his own statement on page 211 of the same article — he states, "It is well known that friction in a bearing with oil as a lubricant does not increase in proportion to the pressure at a constant ratio."

Mr. C. J. H. WOODBURY'S experiments and the experiments of others referred to in Dr. THURSTON'S "Treatise on Friction and Lost Work," (See especially WOODBURY'S table page 325) make it plain that the coefficient of friction upon oiled bearings varies generally (within certain limits for each oil) in an inverse ratio to both pressure and temperature. That is to say, we are to expect the coefficient of friction to diminish as the band pull increases, and as the temperature increases, and vice versa. In experiments upon the twelve oils these factors were generally operating in opposite directions, tending to make the spindles per horse power more nearly constant than the horse power per pound of band pull.

In the experiments with weighted tape bands the element of change was confined to the band tension, the temperature of spindle fortunately remaining constant, and we have the practical illustration of the relation of band pull to the coefficient of friction for this particular temperature, spindle and oil. (This oil was the No. 3.) Thus:

THURSTON'S formula for lost work for cylindrical surfaces is (page 102) $H.\ P. = \frac{f\ P\ R\ d}{127{,}700}$, where f = coefficient of friction, P = pressure (corresponding in some measure with band pull), R = revolutions per minute, and d = diameter of journal in inches. Assuming that this formula can be applied without modification to this spindle the values of f have been inserted in the sixth column of Table 3, and these figures evidently bear a constant ratio to the horse power per pound of band pull, whose curve of change is shown in Diagram No. 12. This curve approximates closely a parabola in form.

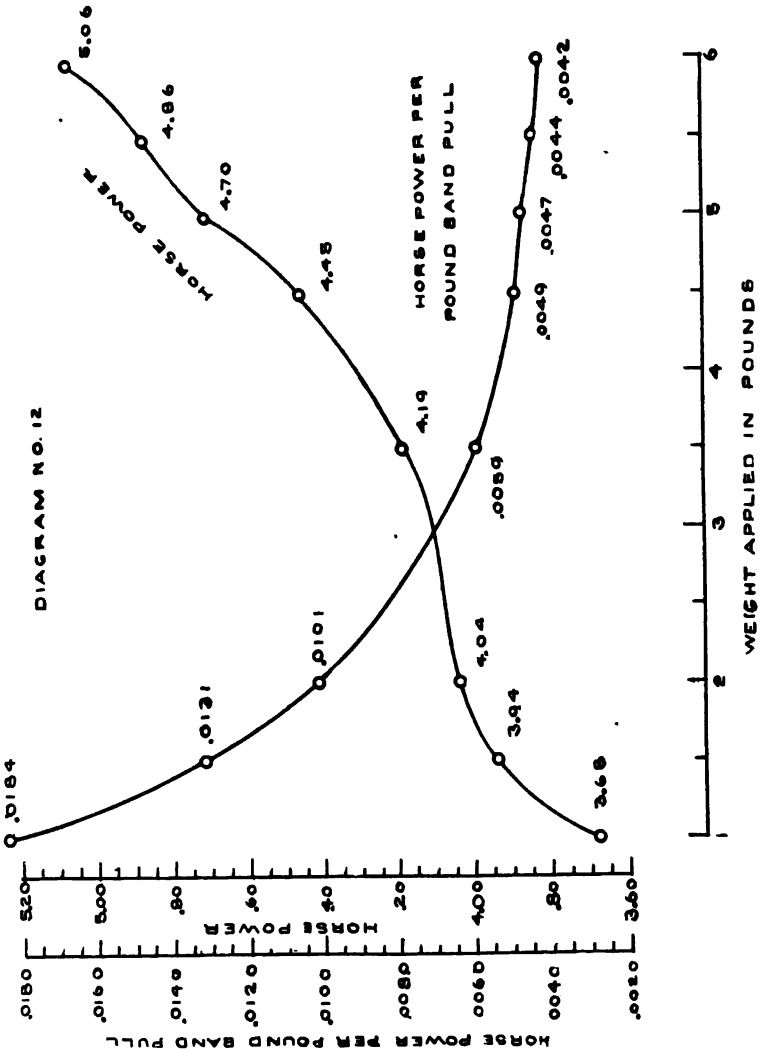
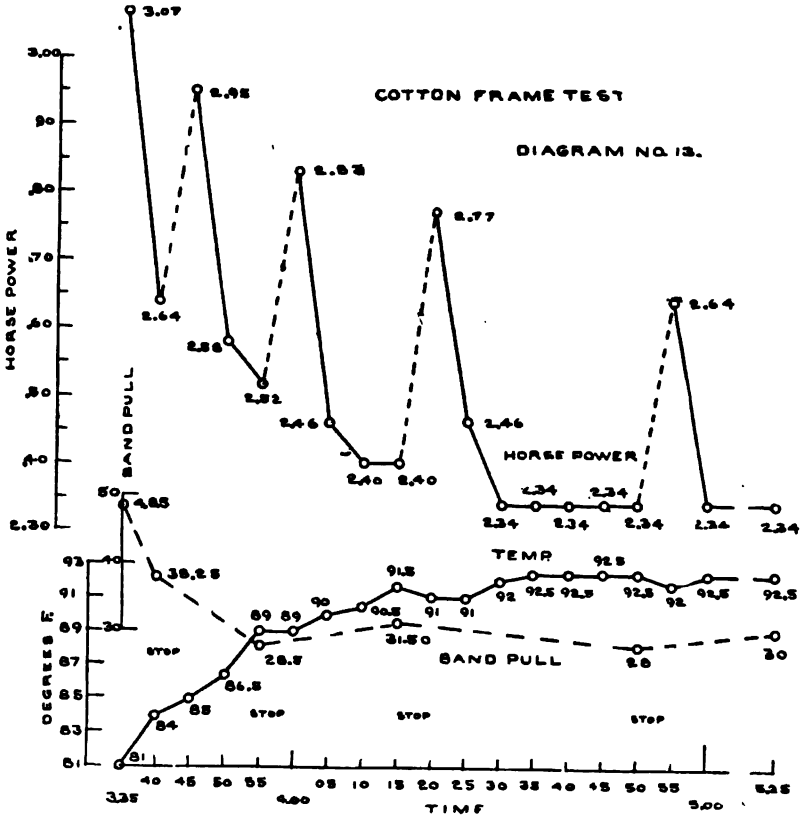


DIAGRAM NO. 12
HORSE POWER
HORSE POWER PER POUND BAND PULL
WEIGHT APPLIED IN POUNDS
5.06
4.86
4.70
4.48
4.19
4.04
3.94
3.68
.0184
.0131
.0101
.0089
.0049
.0047
.0044
.0042
520
500
480
460
440
420
400
380
360
.0180
.0160
.0140
.0120
.0100
.0080
.0060
.0040
.0020
1
2
3
4
5
6

It is not to be wondered at, however, that the weighted tape band has not been utilized in the cotton industry, because it requires a wider frame for this purpose, and this would mean a greater number of square feet per spindle in the construction of buildings — a serious matter. On the worsted spinning frame, however, the width required for the length of rack was in itself sufficient for the use of the weighted band, and there was no loss of room in making the change. The ordinary ring twisting frame as used by cotton mills is also too narrow for a tape band, as at present weighted. Perhaps some better weighting method, occupying less room, can be devised.

I have seen a blue print of a frame only thirty-six inches wide with an attempt to use just such an arrangement, but the way it is done is by putting the cylinder out of centre so as to give a chance for the band weights on the wider side. That of course might be difficult to accomplish in frames already in existence, because of necessitating changes in the gearing and so forth. But in building new frames it might be practicable with thirty-six inch frames if there was nothing any better than that.

The writer recognizes also the fact that there is some lack of uniformity of speed between the four spindles driven by one band, but from the experiments which he has tried he thinks this difference is decidedly less than the variations which generally accompany the use of the ordinary hook or loop band. In making double and twist worsted yarns he has always been able to obtain greater uniformity of twist on a frame banded in this manner over a frame using the loop or hook band, no matter how tight the bands were intended to be kept to prevent slack twist. It would appear, therefore, that something yet was needed for an ideal method of driving spindles. When some electrical inventor can introduce a method of driving spindles with absolute uniformity, and without varying stress, and at not too great a cost, one of the most important conditions for satisfactory mill work will have been brought about.



In the preparation of this paper the writer desires to acknowledge the very efficient services of his assistant, Mr. JOHN A. COLLINS, JR., who conducted all the experiments and made all the diagrams and tables herein referred to. His special thanks are also due to Mr. WILLIAM F. PARISH, JR., who gave valuable advice, loaned instruments and conducted a series of tests for him, using an electric motor as a power scale, which tests, though valuable in themselves as illustrating some of the facts here brought out, are not, however, here recorded.

TABLE I.—COMPARATIVE OIL TESTS.

SUMMARY OF RESULTS.

		START.					FINISH.				
No. of Oil.	No. of Test.	Horse Power.	Band Pull.	H. P. per lb. B. P.	Spindles per H. P	Spindle Temp.	Horse Power.	Band Pull.	H. P. per lb. B. P.	Spindles per H. P.	Spindle Temp.
1	1	5.00	370	.0135	37	69.	3.02	286	.0106	60	85.
	2	4.88	354	.0137	38	73.5	3.02	296	.0102	60	88.
	3	4.29	354	.0121	43	74.	2.88	244	.0118	64	89.
	4	4.08	336	.0121	45	74.5	2.74	220	.0125	67	91.5
	5	5.34	360	.0148	34	67.	3.23	280	.0115	57	83.5
	Aver.	4.72	355	.0132	39.4	71.6	2.98	265	.0113	61.6	87.4
2	1	3.31	360	.0091	55	69.5	2.67	286	.0093	69	74.5
	2	4.01	344	.0116	46	69.	2.81	300	.0093	65	83.5
	3	3.66	324	.0113	50	72.	2.74	278	.0098	67	83.5
	4	3.31	288	.0115	55	73.	2.60	248	.0105	71	86.5
	5	3.66	324	.0113	50	74.5	2.74	282	.0097	67	89.
	Aver.	3.59	328	.0109	51	71.6	2.71	279	.0097	67.4	83.4
3	1	3.66	368	.0099	50	70.5	2.88	300	.0096	64	83.5
	2	3.31	300	.0110	55	70.	2.67	300	.0089	69	83.
	3	3.45	344	.0100	53	69.5	2.74	346	.0079	67	85.
	4	2.95	392	.0075	63	77.5	2.46	332	.0074	75	88.
	5	3.45	372	.0092	53	74.	2.52	340	.0074	73	88.
	Aver.	3.36	355	.0095	54.8	72.3	2.65	324	.0082	70	85.5
4	1	4.36	406	.0107	42	75.5	3.45	350	.0098	53	92.5
	2	3.87	330	.0117	48	76.	3.31	308	.0107	55	92.5
	3	3.51	338	.0104	52	75.	3.16	300	.0105	58	85.
	4	3.73	342	.0109	49	71.	3.45	320	.0108	53	85.5
	5	4.01	316	.0126	46	74.	3.16	300	.0105	58	85.5
	Aver.	3.89	346	.0112	47.4	74.3	3.30	315	.0104	55.4	88.2
5	1	3.66	390	.0094	50	75.5	3.02	300	.0100	60	90.5
	2	4.08	376	.0109	45	71.	3.09	300	.0103	59	88.5
	3	3.59	314	.0114	51	76.	2.81	270	.0104	65	89.
	4	4.29	360	.0119	43	71.	3.09	284	.0109	59	86.
	5	3.66	324	.0113	50	77.	3.02	324	.0093	60	87.5
	Aver.	3.85	353	.0109	48	74.1	3.00	295	.0102	60.6	88.3
6	1	4.71	328	.0143	39	76.	3.45	274	.0126	53	95.
	2	4.36	290	.0150	42	73.	3.45	284	.0122	53	91.
	3	4.36	312	.0140	42	73.	3.45	312	.0110	53	89.5
	4	4.50	300	.0150	41	70.	3.51	268	.0131	52	90.5
	5	4.57	330	.0138	40	73.	3.51	302	.0116	52	92.
	Aver.	4.50	312	.0144	40.8	73.	3.47	288	.0121	52.6	91.6

TABLE I.—CONTINUED.

		START.					FINISH.				
No. of Oil.	No. of Test.	Horse Power	Band Pull.	H. P. per lb. B. P.	Spindles per H. P.	Spindle Temp.	Horse Power.	Band Pull.	H. P. per lb. B. P.	Spindles per H. P.	Spindle Temp.
7	1	4.50	348	.0130	40	75.	3.59	287	.0125	51	93.
	2	4.15	284	.0146	44	73.5	3.51	273	.0128	52	91.
	3	4.71	420	.0112	39	75.5	3.59	332	.0108	51	93.
	4	4.57	408	.0112	40	79.	3.66	350	.0105	50	94.
	5	4.29	340	.0126	43	73.	3.59	300	.0119	51	90.5
	Aver.	4.44	360	.0125	41	75.2	3.59	308	.0117	51	92.3
8	1	4.71	377	.0125	39	73.	3.45	300	.0115	53	89.
	2	4.50	390	.0115	41	69.5	3.66	350	.0105	50	89.5
	3	4.85	390	.0124	38	71.	3.73	350	.0106	49	89.
	4	4.22	352	.0120	43	69.	3.87	336	.0115	48	81.
	5	4.08	390	.0104	45	70.	3.87	350	.0110	48	88.5
	Aver.	4.47	380	.0118	41	70.5	3.71	337	.0110	49.6	87.4
9	1	4.15	170	.0244	44	90.	3.51	124	.0282	52	99.
10	1	4.78	310	.0154	39	82.	3.51	190	.0185	52	86.5
	2	6.26	510	.0123	29	72.	3.66	198	.0185	50	77.5
	3	5.77	380	.0152	32	75.	3 94	230	.0171	47	81.5
	4	5.20	280	.0185	35	80.	3.31	184	.0180	55	83.
	5	4.15	156	.0266	44	86.5	3.31	104	.0318	55	92.5
	Aver.	5.23	327	.0176	36	79.1	3.54	181	.0207	51.8	84.2
11	1	4.85	268	.0181	38	81.	3.31	176	.0188	55	87.
	2	4.71	200	.0235	39	82.	3.31	144	.0230	55	88.5
	3	4.01	240	.0167	46	82.	3.16	150	.0210	58	87.
	4	5.36	270	.0200	34	80.	3.09	160	.0193	59	85.
	5	5.77	410	.0140	32	82.	3.31	170	.0194	55	91.
	Aver.	4.94	277	.0184	38	81.4	3.23	160	.0203	56	87.7
12	1	4.36	410	.0106	42	72.	3.51	346	.0101	52	90.
	2	5.41	466	.0116	34	74.	4 29	420	.0102	43	91.
	3	4.57	322	.0142	40	76.	3.87	332	.0116	47	91.5
	4	4.36	310	.0140	42	74.	3.73	320	.0117	49	90.
	5	4.71	288	.0163	39	72.	3.80	304	.0125	48	87.
	Aver.	4.70	360	.0133	39.4	73.6	3.84	344	.0112	48	89.9

TABLE No. 2.

CHANGE IN BAND TENSION AFTER VARIOUS INTERVALS OF RUNNING.

272 SPINDLE WHITIN. TOTAL BAND PULL. Start = 560 Finish = 345

TIME. 3.30 to 3.35	3.40 to 3.45	3.55 to 4.00	4.15 to 4.20	4.50 to 4.55	5.25 to 5.30
3.5	3.0	2.25	2.5	2.	2.
1.25	1.25	.75	1.	1.	1.
1.25	1.	1.	1.	1.	1.
2.	2.25	2.	1.75	1.5	2.
.5	.5	.5	0.5	0.5	0.5
1.	.75	.75	.75	.75	.75
1.25	1.	1.	.75	1.	.75
2.	1.5	1.25	1.5	1.5	1.5
2.	.75	.75	.75	1.	1.
1.5	.75	.5	1.	.75	.75
1.75	1.	1.	1.	.75	1.
1.5	.75	.75	.75	.5	.75
1.75	1.	.75	.1	.75	1.5
2.	1.75	1.	1.5	1.25	1.
1.25	1.5	1.	1.	.75	1.
1.5	1.5	1.	1.25	1.	1.
3.	2.5	1.5	2.	1.75	2.
2.	1.25	.75	.75	.5	.75
2.75	1.5	.75	1.	1.	1.25
2.	1.5	1.5	1.	1.	1.25
2.25	1.5	1.25	1,	1.	1.
2.5	2.	1.5	1.5	1.5	1.
4.	3.25	2.	3.	2.25	2.5
2.5	3.	2.	2.25	2.	1.75
1.5	1.5	1.	1.	1.	1.
48.5	38.25	28.50	31.50	28.	30.

Time.	Room Temp.	Rel. Hum.	Spdl. Temp.	H. P.	Spin. per H.P.
3.35	81.	61	81.	3.07	*89
.40	80.	63	84.	2.64	
.45	80.	64	85.	2.95	*
.50	80.	64	86.5	2.58	
.55	80.	64	89.	2.52	
4.	80.	64	89.	2.83	*
.05	79.5	64	90.	2.46	
.10	79.5	64	90.5	2.40	
.15	80.	64	91.5	2.40	
.20	80.	64	91.	2.77	*
.25	80.	64	91.	2.46	
.30	80.	64	92.	2.34	
.35	79.	64	92.5	2.34	
.40	79.	64	92.5	2.34	
.45	79.	68	92.5	2.34	
.50	79.	68	92.5	2.34	
.55	79.	68	92.	2.64	*
5.	79.	68	92.5	2.34	
5.25	79.	68	92.5	2.34	*116

* Frame stopped to take band tension.

TABLE No. 3.

POWER SCALE TEST ON TWISTER.

200 SPINDLE PRINCE SMITH RING-TWISTER; RABBETH TYPE SPINDLE.

Diameter Drum, 10″; Diameter Whorl, 1⅛″; Spindle Speed 7,400.

Wgt. on Bands.	Speed Drum.	Horse Power.	Spindles per Horse Power.	Horse Power Per l.b. Band Pull.	f	Spdl. Temp.	Room Temp.	Rel. Hum.
1 lb.	843	3.68	54	.0184	.84	84	73	42
1 "	843	3.68		.0184		84	73	42
1.5 "	843	3.94	50	.0131	.60	84	73	42
1.5 "	843	3.94		.0131		84	73	42
2 "	843	4.04	49	.0101	.46	84	74	43
2 "	843	4.04		.0101		84	74	43
3.5 "	843	4.19	48	.0059	.273	84	72	42
3.5 "	843	4.19		.0059		84	72	42
4.5 "	843	4.45	45	.0049	.225	84	73	42
4.5 "	843	4.45		.0049		84	73	42
5 "	843	4.70	42	.0047	.216	84	73	42
5 "	843	4.70		.0047		84	73	42
5.5 "	843	4.86	41	.0044	.202	84	75	40
5.5 "	843	4.86		.0044		84	75	40
6 "	843	5.06	40	.0042	.193	84	75	40
6 "	843	5.06		.0042		84	75	40

$$\text{H. P.} = \frac{f\,P\,R\,d}{127{,}000} \qquad R = 7{,}400 \qquad d = .375 \qquad f = \frac{\text{H. P.} \times 127{,}000}{P\,R\,d}$$

The PRESIDENT. Gentlemen, Mr. HARTSHORNE has given us a very valuable contribution for our Transactions. Are there any questions to be asked in reference to this?

Mr. GEORGE OTIS DRAPER. Mr. President, I notice there is something on page 165 which Mr. HARTSHORNE did not refer to but which is printed, in which reference is made to a former paper of mine in which I appear to be arguing against myself, and I am very thankful to Mr. HARTSHORNE for calling attention to a very plain error. Where I said in a former paper that "The ratio of power consumption to band tension is found to be uniform enough," etc. I should really have said, "The *variation in the rate* of the ratio is uniform enough." That is, the ratio varies, but in plotting a curve the curve would be constant enough so that could be figured. Now in relation to this new form of banding it strikes me offhand in looking at the diagram that where one band has to drive four spindles, that one band must necessarily be at a much higher tension to carry the load of those four spindles than any one of four single bands, each driving a spindle; and while you might get a more uniform speed and a more uniform tension, the question arises whether the total power consumed under this system might not be much greater than with the single banding system. That is simply a query that arises in my mind in looking over the paper.

Mr. WILLIAM D. HARTSHORNE. I think I can give some light upon this point. At the time when we changed all of our worsted spinning frames on to tape bands we were consuming in the neighborhood — I don't know that I ought to try to name figures, but I can give you some idea in relation to it — we were consuming say five horse power to a frame for spinning purposes. When we changed to the tape band that was reduced to about three and a half horse power — between three and a half and four; a very considerable reduction on the same kind of work. I might further say that this Rabbeth spindle which was tried with tape bands, of which we have here a sample is,

you will notice, a larger spindle than this one which was on the Fales & Jenks machine. At the time when the first test was made we were only driving these Fales & Jenks spindles about 6,000; they figure about 6,400. We did not start up this new frame at that speed; we started up at 7,400, and with the result, as you will notice on the tables, that although the number of spindles per horse power is greater on this No. 3 oil on the Fales & Jenks spindle at 6,000, it is not really so considering the difference in speed and size of spindle. After we had applied this oil to the spindle on the Fales & Jenks frame we put the speed up to 7,400. I have since tested the horse power, not on the bare spindles alone, but with the frame twisting about the same kind of yarn on each kind of frame where the speed was practically the same, and the frame using the tape band gave 29 spindles to the horse power, while the former gave 34 — a difference only apparently against the tape band when you consider the size of the spindle and bobbin. The smaller full bobbin weighs about four ounces; the larger nearly eight.

Mr. GEORGE OTIS DRAPER. Mr. President, this simply shows that fact is a good deal better than theory. Now I would like to ask another question of Mr. HARTSHORNE. I noticed that in the diagram there are some little pulleys, and by the nature of those pulleys and their bearings I would infer they would have to be quite frequently oiled. Is it a cause of any trouble or annoyance?

Mr. WILLIAM D. HARTSHORNE. On the contrary, by using a certain form of wood bearings they need not be oiled more than once a year, perhaps, if at all. In regard to the question of the difference in the speed of the four spindles which I first was much afraid of, I have had a great many tests made of the twist, not by taking the speed of the spindle, because I do not think that is a practical thing to do and find out what you are doing by any ordinary method at any rate, but by taking the twist itself by a number of tests of each spindle. The variation

in twist is really very slight, although it gives a result in favor of spindle No. 1 by the diagram. You will notice which that spindle is by the way it is driven. The average there on the regular weight of three and a half pounds of ten tests on a given sample of yarn was 10.68 turns per inch, but on the other three spindles it was 10.21, 10.24 and 10.32. You will observe therefore that the difference is very small, but the twist is slighly greater on the No. 1 spindle; that is, on the normal weight. If you use a weight less than that — we experimented in this manner as to whether that was the right weight; we tried one pound, 1½ pounds and two pounds, as you see by the table, but at less than 3½ pounds weight there is a vibration which takes place in the banding and we get irregular twists; we do not have the same regularity. For instance, on the one pound weight the turns from the No. 1 spindle, which ought to be the largest, averaged 9.79 against a little over 10 in the other spindles. A great deal more regularity is produced by that 3½ pound weight than by any lower weight, and it is unnecessary to have any higher weight.

Mr. GEORGE OTIS DRAPER. Mr. President, I do not want to ask all the questions, but this power testing has always been a great hobby of mine and I would like to ask Mr. HARTSHORNE about the actual gravity of that No. 3 oil that came out the best in the test — not that I assume that the gravity was the governing feature, but as a matter of interest. Perhaps the diagram shows it.

Mr. WILLIAM D. HARTSHORNE. The diagram shows it — both the viscosity and the specific gravity — diagram No. 9 — and as related to all the others. The diagrams are intended to show relation rather than specific figures, although in the Transactions as finally printed, the actual specific gravity of each of these oils can be shown as well as its viscosity. I have just called attention to that point, that No. 3 is relatively light compared with No. 2, the next best oil, which was the heaviest of the series, and also the most viscous excepting No. 1. I will

say in regard to No. 1, that this is an oil which we have been using for a great many years for a great many purposes. We have used it on light shafting, we have used it on open spindles, and we use it on these bath spindles. Its adaptability was over a wide range on account particularly of its high viscosity at the lower temperatures.

Mr. GEORGE OTIS DRAPER. Mr. President, on this question of spindle oil and referring to the question raised by Mr. PREST, it seems to me the real facts the cotton manufacturers want to know are either what oil manufactured by any manufacturer is the best for them to use or how they can determine out of several oils by tests which one to use. I personally started in testing oil on spindles back in 1888, carrying on the series of six months' tests from which General DRAPER wrote his original paper on oiling spindles, and since that have carried on several others, and I have made up my mind from my own experiments that there is no real test of gravity or viscosity which will determine the question. You must either rely on the tests made by other parties, on the actual spindles yourself or make the tests yourself. I do not think there is any scientific method by which you can take an oil and test it for gravity or viscosity or in any other way by laboratory test and really know anything about it. That has been the result of my own experience in this line.

Mr. JOHN E. PREST. Mr. President, I would like to ask Mr. HARTSHORNE if he has tested this new banding arrangement with two spindles instead of four. With two spindles it runs with less tension than with four, and it also gets more contact on the spindle whorl. The question is whether he could not use a lighter band and get a more uniform twist instead of driving four.

Mr. WILLIAM D. HARTSHORNE. That is something I have never tried and I don't know whether it has been tried or not.

Mr. THOMAS H. SMITH. I suppose in this table No. 3, where Mr. HARTSHORNE speaks of bands, he means tapes?

MR. WILLIAM D. HARTSHORNE. Tape bands.

Mr. THOMAS H. SMITH. Suppose he used the word the tapes, there would be no confusion, that is the English term for it.

Mr. WILLIAM D. HARTSHORNE. Tapes, yes.

Mr. C. J. H. WOODBURY. Mr. President, in years past I made some experiments on lubrication and on frictional lubrication, and I wish to ask the speaker if he has ever in his experiments found anything to indicate the wearing out of an oil; and by that question I do not mean to ask whether he has ever learned anything to indicate the impairment of lubricating property, because the lubricating power of an oil is impaired by the taking up of foreign material from the attrition of the journal, and also in certain classes of oil by evaporation of a portion of the lubricant, and in others by oxidation, making a different material to that extent by the chemical change. But I mean if the use of an oil actually indicates any molecular change which changes its characteristics as a lubricant.

Mr. WILLIAM D. HARTSHORNE. I have never made any experiments in that line directly, and those that I have observed, I think, might be accounted for in a different manner; as, for instance, in these same frames to which I referred, we began oiling them with this No. 1 oil and we soon found that the bearings were becoming sticky and disturbed and considerable wear in connection with them; but just how much that was due to some other fault than the oil I am not able to say. But we have had no such difficulty on the same frames in a later lot which came in which never had any No. 1 oil on them—only the No. 3.

The PRESIDENT. Any further questions?

Mr. THOMAS H. SMITH. I would like to ask Mr. HARTSHORNE

if he has ever experimented with a double cylinder frame — two cylinders in a frame?

Mr. WILLIAM D. HARTSHORNE. I have not. I have never seen a frame with two cylinders.

Mr. THOMAS H. SMITH. This question of banding is one that in England was solved a good many years ago by using two cylinders to the frame. Why that is not done here I don't know. Nobody uses it here. Somebody told me that the experiment had been tried without good results. It is a strange thing why a thing can be used in one country and won't answer in another. But in England you cannot give away a frame with a single cylinder. The double cylinder has this advantage about it: It will carry a straight band to the spindle.

The consequence is you have got more contact with the whorl and can run a tighter twisted band. In this country you can not use it at all. I think the model driving is the method that Mr. HARTSHORNE has spoken of — the tape bands. You get a larger surface contact with tape and get a steadier speed. That has never been used in this country to my knowledge but I have seen it used for cotton spinning in England. I don't know why it should not be, especially as Mr. HARTSHORNE says by putting the cylinder on one side you can get the advantage with a narrow frame. Have you ever tried that, Mr. HARTSHORNE?

Mr. WILLIAM D. HARTSHORNE. I have not.

Mr. JOHN E. PREST. In regard to two cylinders, some years ago — perhaps twenty years — spinning frames were built with two cylinders. Mr. SMITH says it gave better contact on the spindles — the band would pull straighter. I think that the WHITIN people built quite a number of frames at that time of this kind. They built a frame which was about thirty inches wide — nearly thirty-six. Those frames were put in and proved a failure. I think some Fall River manufacturers had some

experiments in that line and went to the expense of changing them over. In fact I bought some frames myself and put them in and only recently—within two months—I have taken out frames with two cylinders and put them in scrap. Now it would appear that the band had a better hold on the spindle, but you lose it on the cylinder. The bands will not last as long. They wear on the second cylinder. Of course you get a straight pull on the band from one whorl to the other, but going around one cylinder and up over the other there is a slip there between the different bands—the different tensions—the bands are not all of one tension and the bands do not last as long as they do on one cylinder.. The tight bands wear out more quickly than do the slack ones. We find we get the best results with frames built as they are at the present day, with one cylinder, the regular seven inch cylinder, and thirty-nine inch frame, each spindle banded independent of the other.

The PRESIDENT. We will now proceed with the reading of the next paper, "The World's Supply and Consumption of Cotton," by Mr. S. N. D. NORTH.

Mr. S. N. D. NORTH. I observe in the morning papers that there was an address delivered here by Mr. MAURY last evening which covered quite a little of the ground covered by the paper which I have prepared, but perhaps from a different point of view, and that it criticised much more severely than I have attempted to do the methods which have heretofore prevailed in the government service in reporting the volume of the annual cotton crop.

THE WORLD'S SUPPLY AND CONSUMPTION OF COTTON.

With an Account of the Plan and Purpose of the Census Cotton Ginning Investigation.

S. N. D. North, Chief Statistician, Division of Manufactures, U. S. Census, Boston, Mass.

As a student of the textile fibers my interest has been chiefly in wool — the most interesting, the most difficult, the most wonderful of them all. But I have not failed to realize that cotton, coming last into the field among the four chief fibers, has forced itself into a position where it bears a relation to the world's economic progress more important than that of wool, silk, and flax combined.

The question of the supply and consumption of cotton has thus become of more moment to the commercial world than any other trade question; and any plan or movement on the part of the government or otherwise, which promises materially to improve the mechanism for the statistical measurement of the annual crop, becomes at once a matter of importance to the growers, handlers, and consumers of the fiber, here and abroad.

I have endeavored to demonstrate the relative and the increasing importance of the cotton fiber, by means of a graphic chart, upon which is traced the world's consumption of the five principal fibers, as nearly as possible by ten year periods, for the twelve decades since mechanical spinning was developed. The data for this chart have been gathered from a variety of sources, the most trustworthy I can find.

CONSUMPTION OF TEXTILE FIBRES BY ALL NATIONS,

1780—1900.

Year.	Millions of Pounds.				
	Cotton.	Wool.	Flax.	Jute.	Silk.
1780	220	440	500	. . .	30
1800	303	460	600	. . .	30
1820	402	520	700	. . .	33
1840	1,210	694	800	. . .	35
1850	1,335	886	900	60	37
1860	2,451	1,074	925	130	40
1870	1,675	1,579	1,200	410	42
1880	3,501	1,915	900	900	45
1890	4,817	2,250	800	1,310	50
1900	6,767	2,500	750	1,500	52

Total all fibres, 1780,— 1,190,000,000 lbs.
" " " 1800,— 1,363,000,000 "
" " " 1900,—11,569,000,000 "

It appears that the importance of the three chief fibers, on the basis of consumption, has been reversed during the last one hundred years. Flax, of which a larger quantity was used in 1800 than of any other fiber, now ranks third, and today's consumption is only one and one-fourth times that of one hundred years ago. The consumption of wool has increased five times over what it was at the beginning of the nineteenth century; but whereas there was one and one-half times as much wool used as cotton in 1800, there is now nearly three times as much cotton used as wool; and the increase in cotton consumption was more than twenty-one fold in the century.

The reasons for this phenomenon must be familiar to men whose lives are spent in handling the staple. The relative cheapness of the fiber, and its admirable spinning qualities, are first among these reasons. Our wool growing friends are now asking Congress to pass a law making it a penal offense to manufacture goods containing shoddy, or cotton mixed with wool, unless every piece is tagged with an exact statement of the proportions

of each material. They ignore the fact that the interchangeable use of textile fibers, made possible by improved machinery and processes, marks the point of chief advance in modern manufacture, and has proved of incalculable advantage to consumers.

Ostensibly they seek to curtail the use of shoddy. In reality they strike at cotton; for the census shows that for every pound of shoddy used in the manufacture of mixed goods, there is a pound and a half of cotton used. The American wool grower does not produce within a hundred and fifty millions pounds the quantity of wool actually and annually required by the American manufacture, in addition to all the substitutes used; he insists upon a duty averaging from 50 to 150 per cent. upon every pound of foreign wool imported to make up this deficiency; and yet he demands that the use of any substitutes for the higher priced fiber, which is nearly doubled in cost by the duty, shall be discountenanced by act of congress and branded as a disreputable performance. The onward march of cotton cannot be retarded by any such revival of seventeenth century statutes.

This chart shows that there has been no uniform rate of increase in the consumption of cotton. Many causes interfere to prevent it. The world's demand for cotton goods varies with the world's ability to buy them. Panic and business depression every now and then stop spindles here and elsewhere, in varying proportion; or a "Boxer" insurrection in China works a prolonged suspension in the trade of the Orient. The great Lancashire cotton mill strike of 1892-3 reduced the English consumption by more than 300,000 bales in that year. But demand and supply even themselves up in a long series of years; and it is worth noting that the consumption of cotton doubled in the twenty years between 1840 and 1860, and that it increased over 90 per cent. in the twenty years between 1880 and 1900. This is equivalent to an average increase of 4½ per cent. per annum, in the last twenty years, or an average increase of 163,000,000 pounds per annum. There is no reason to doubt that this average rate of increase will continue indefinitely. The present users of cotton continually use more of it, and wider

markets are constantly opening, in South and Central America, in Africa, and in the Orient. It is perfectly reasonable to assume, with this chart before us, that the world's consumption of cotton, in the year 2000, will be over 50,000,000,000 pounds per annum. Such figures seem incredible, but they are no more remarkable than was the increase from 1880 to 1900.

It becomes an important question, therefore, whence is to come a supply of cotton to meet this increasing consumption.

In 1900, the seventeen states of the cotton belt of the United States, including Oklahoma and the Indian Territory, produced 10,123,027 bales, of 500 pounds each, or 5,061,513,294 pounds, which comprised two-thirds of the world's crop of that year, the remainder coming —

3,300,000	bales	from	East India:
1,450,000	"	"	China:
884,600	"	"	Egypt:
250.000	"	"	Asiatic Russia:

And scattering amounts, not commercially important, from Africa, South America, Turkey, etc., making a total supply of about 16,000,000 bales.

The Southern cotton crop for the last one hundred years, with the rate of increase in each ten years, has been shown on Chart 2, as follows:*

* The census of 1840, collecting statistics of the crop of 1839, marked the beginning of the inclusion of agricultural products in census inquiries. The statistics given in the above table for 1839 and for years subsequent thereto are the results of special census investigations. The cotton production of the United States from 1790 to 1829 inclusive, as shown in this table, is based upon a report to the Speaker of the House of Representatives in 1836 by the Hon. LEVI WOODBURY, Secretary of the Treasury.

Crop of	Production in Bales.	Average Bale Weight.	Total Gross Weight.		
			Pounds.	Increase.	
				Pounds.	Per Cent.
1790	8,889	225	2,000,025	. . . . .	. . .
1800	177,778	225	40,000,050	38,000,025	. . .
1810	320,000	250	80,000,000	39,999,950	100.
1820	681,819	264	180,000,216	100,000,216	125.
1833	1,312,685	339	445,000,215	264,999,799	147.2
1839	2,053,193	385	790,479,305	345,479,090	77.6
1849	2,469,693	400	987,637,200	197,157,895	24.9
1859	5,387,052	445	2,397,238,140	1,409,600,940	142.7
1869	3,011,996	440	1,325,278,240	*1,071,959,900	*44.7
1879	5,755,359	453	2,607,177,627	1,281,899,387	96.7
1889	7,472,511	477	3,564,387,747	957,210,120	36.7
1899	9,645,974	485	4,672,695,500	1,108,307,753	31.1
1900	10,486,148	483	5,061,513,294	388,817,794	8.3
1901	9,954,945	478	4,754,872,521	*306,640,773	*6.1

*Decrease.

The area in cotton increased 20.3 per cent. in the decade from 1889 to 1899; the production 32.3 per cent.; the average yield per acre, 10 per cent.; and the average weight of bales 3.8 per cent. During the decade 1890 to 1900, the population of the ten states which produced most of the cotton increased 22.7 per cent., which is slightly above the increase in the cotton-growing area, but considerably below the increase in production of cotton.

This chart makes it clear that the South has been able to keep fully abreast of the world's increasing consumption of cotton, except during the period of the Civil War. This has been true of no other cotton producing country. The percentage of increase has differed very widely in the different decades, and there have been marked fluctuations in the amount of the annual crops. Two variations, almost startling in amount, occurred during the last decade in the Southern crop. The crop of 1893 was 1,153,917,000 pounds smaller than that of 1892, a decrease of 25.6 per cent.; and the crop of 1900 was 1,037,665,000 pounds less than that of 1899, a decrease of 17.9 per cent. These variations arose chiefly in the state of Texas, whose crop

of 1899 was 964,000 bales less than that of 1898, a shortage of 27 per cent.

But these fluctuations in the Southern cotton supply have not been very greatly more marked than the fluctuations in the consumption, attributable to other causes; and there has never been a period in the last thirty years when the world has faced the possibility of a cotton famine, even between seasons. We have seen that the world's consumption increased 90 per cent. in the twenty years from 1880 to 1900, and the Southern crop doubled in the same period.

This has been almost exclusively due to the extraordinary growth of the crop of Texas.* No other Southern state has shown any marked increase during the interval. Texas is the marvel of the cotton belt. In 1850 it grew less than 60,000 bales. In 1900 it grew 2,594,442 bales, or 34 per cent. of American grown cotton, and more than one-quarter of the world's supply. This map, from Census Bulletin No 206, shows what a small part of the state is yet given over to the cotton crop. One hundred and sixty-six counties out of the 246 in the state grew all the crop in 1901, and 75 of these 166 counties grew 87.6 per cent. of it.

So that the room for future growth in Texas alone is sufficient to meet the world's requirements for fifty years. In a recent interview Ex-Governor SAYERS said: "Not exceeding one-third, if so much, of the strictly cotton area of Texas is now under cultivation; and if the assurance could be given that for ten years in succession the price of cotton at the gin would average eight cents per pound, the annual product of the state would within that time reach fully 10,000,000 bales. This is not an

* Of the total increase of 4,099,831 acres in the decade, 3,637,398 acres, or 88.7 per cent., were contributed by Texas, the Indian Territory, and Oklahoma. The increase in Texas was 3,025,842 acres; in Indian Territory, 371,987 acres; in Oklahoma Territory, 239,569. This leaves an increase of only 462,433 acres for all the other states, which was nearly reached by the increase of 440,970 acres in Alabama. Substantial gains were made in Georgia, Louisiana, and South Carolina, and a slight gain in Mississippi, but the gains of these states were offset by the decreases in Arkansas, Florida, Kentucky, Missouri, Tennessee, and Virginia.

exaggerated] statement nor is it based upon the cultivation of cotton exclusively in such area, proper allowance being made for the diversification of crops."

Oklahoma and Indian Territory, equally favorably situated for cotton growing, have just entered upon the cultivation; they have possibilities equal to the most favored sections of Texas. In 1889 the two territories reported only 34,540 bales; but in 1899 they reported 225,525 bales, an increase of over 550 per cent.* The combined area of the Indian and Oklahoma Territories is 69,830 square miles, which is only about 6,000 square miles less than the combined area of Mississippi and South Carolina; and these two states produced in the year 1898, as commercially reported, 2,736,000 bales. It is therefore entirely safe to assume that the territories with their superior soil may produce as much as 2,500,000 bales.

Mr. EDWARD ATKINSON has calculated that the whole cotton crop of the globe can be grown upon about two acres out of each one hundred of the cotton producing states, which means room for indefinite expansion.

If the South shall continue its present proportion of the supply, it will be growing 15,000,000 bales of cotton in 1925, the greater part of which will come from the fresher lands, west of the Mississippi River, where cotton can be grown for from one and a half to two cents a pound cheaper than in the states of the Atlantic belt.

The conclusion is warranted, therefore, that the future of the cotton trade is securely within the hands of the American producers, if they choose to have it so; equally clear is it that in order to retain the control of a crop which has been worth four billion dollars to the south since 1878, there must continue to be a gradual increase, and not a curtailment of the southern acreage.

Notwithstanding the fact that the southern crop has thus kept abreast with the constantly growing demand for cotton, and is capable of continuing indefinitely to supply a demand continually

* Twelfth Census — Agriculture, Part II, page 412.

increasing, there exists today in Great Britain, until very recently the chief cotton consumer, profound dissatisfaction with the conditions surrounding the cotton supply. The Manchester mill owners allege periodical shortage in supplies, resulting in fluctuations in prices, which make manufacturing a constant speculation, production being often at a loss, and organized curtailment frequently necessary. Such a curtailment is actually in progress at present; and it has led to another movement, which is worthy of serious attention on this side of the Atlantic. There has recently been organized at Manchester the "British Cotton Growing Association," the object of which is to exploit, encourage and organize new sources of supply of the raw material, particularly within the limits of the British Empire. It is encouraged by the success of the Russian Government, whose irrigation works on the Amur and Murghab Rivers in Asiatic Russia have resulted in a considerable supply of marketable cotton; by the widening area of irrigated cotton lands in Egypt, under governmental auspices; and by the German movement to grow cotton in her African possession of Togsland, where colored pupils of Booker T. Washington's Tuskegee School are said to be successfully instructing the natives in the cultivation of cotton.

Forty years ago when Lancashire was starving for want of cotton, the "Cotton Supply Association" was organized, with a similar purpose. After efforts which gradually grew less energetic, it disappeared, with but small results to show for its propaganda. It did succeed in doubling the quantity of East Indian cotton; but as soon as our civil war was over, and the southern supply resumed, the English dropped the despised Surat, and returned to our stronger stapled upland, which today constitutes 80 per cent. of their consumption.

Since that day vast areas of Africa, admirably located for cotton growing, and watered by magnificent rivers, have come within the purview of civilization. Thither turn the eyes of the Lancashire spinners, as well as to parts of British Asia, Borneo, and portions of Australia; and to promote and encourage a

growth of the staple at the most promising points, a preliminary fund of $250,000 has already been pledged and agents and supplies sent abroad.

But why should these Englishmen be so disturbed about their future supply of cotton in view of the wonderful record of the South? The *Textile Recorder*, of Manchester, attempts to answer the question: "At regular intervals there is a demand for the curtailment of production of cotton yarns in Great Britain, arising often from either a scarcity or a lockup of the raw material. One of two conclusions must be drawn from this state of things. Either the limit of consumption has approached that of supply, or there is still power existing to prevent the crop being freely marketed". And the *Recorder* concludes, "Our only possible chance of maintaining the cotton industry is the assurance of an ample supply of good cotton at all times. This is always doubtful".

Neither of these conclusions is sustained by the facts. The consumption has at no time during the past ten years reduced the world's cotton supply, visible and invisible, on January 1st, below a million bales, according to the statistics of the "Liverpool Cotton Association"; and at no time during the last twenty years has the stock in sight in Great Britain on January 1st fallen below 870,000 bales, and it has generally exceeded 1,000,000 bales, or nearly one-third of the annual consumption of that country.

The second contention, that the American crop is becoming the subject of organized speculative movements in the United States, involving possibilities in the nature of recurring "corners", is, from the American point of view, preposterous. The first answer to the charge is the fact that the ruling price of cotton has long been made by the Liverpool market. But England's control over the price of cotton is no longer what it once was. Twenty-five years ago Great Britain consumed more cotton than all the rest of the world. Today her consumption is less than one quarter of the world's total consumption, and this is the true secret of the complaint we have quoted.

The second and more conclusive answer is found in the average price of cotton for the last ten years. This average price was 20 per cent. below the average price of the decade immediately preceding; and this price condition is reflected in today's prices.*

The real fact is, that the Manchester manufacturer having had a taste of six cent cotton in 1896, can not forget that experience and cannot dissociate it from some of his present troubles. Whenever the demand for cotton goods falls off, lower prices follow; and unless there is a corresponding decline in the raw material, the manufacture becomes unprofitable. This is precisely the situation existing in England today. The present movement for curtailment in Lancashire is not due to short supplies of material, but to unsatisfactory prices for yarns.- The margin between the cost of cotton and the prices of yarn is now so close, that in the English manufacture, the difference between a new cotton mill, a middle-aged mill, and an old mill, is about the difference between a reasonable profit, a bare meeting of expenses, and an almost chronic deficit. This fact explains why some 20 per cent. of the Lancashire machinery capacity has entered into agreement to suspend spinning for a day and a half each week, while there are constant records of the "christening" of new mills in the district. The new mill promises profit while the old mill faces ruin.

The American cotton grower may very well claim that he cannot be expected to sell his crop at a figure which will permit the worn-out cotton mills of England to continue to earn a profit on the original investment. He naturally associates the present low price of cotton—low in comparison with that of 1890—with the 3,000,000 bales which mark the increased size of his crop in the interval. Whether or not cotton can be grown at a fair profit, at a price less than that now prevailing, it seems doubtful if this can be done east of the Mississippi

* In the last twenty years, from 1872 to 1894, cotton has decreased 70 per cent. in value; wheat 60 per cent.; and general commodities, 50 per cent. (Report of the Industrial Commission, 1900, Vol. I, page 143.)

river, or in sections of the South where there must be a large expenditure for fertilizers in order to secure a remunerative yield per acre. The probability of a successful cotton harvester is increasing. This present season marks the first regular contract ever made in the world to pick cotton. Should such a machine prove successful it would revolutionize the cotton growing industry, and materially reduce the price of the staple.

The Lancashire manufacturers must not overlook the fact that simultaneous with their own organization for curtailment of production and the development of new sources of supply of the raw material, are the movements in the South for the organized reduction of cotton acreage. The grower is as much interested in a limitation of the crop that will put prices up, as is the Lancashire mill man in an increase in the world's acreage that will put prices down. On the crop of 1900, an average of one cent per pound above the average price at which it was sold, would have added $53,000,000 to the wealth of the South. That sum of money means as much to the growers as it does to the stockholders of the Manchester mills. England's cotton manufacture is her most important wealth-earning industry. Her cotton crop is the chief money getter of the South. England needs more cotton every year, and she prefers the Southern cotton to any other, because for her special uses it is better than any other. The most important thing for England today is that the South shall continue to increase her cotton acreage in the future in about the ratio that she has increased it in the past thirty years. On the other hand, it is equally important to the South that she shall retain, in the future, the supremacy as the world's cotton producer, which now belongs to her. This she can only do by continuing to regularly increase her average cotton crop at the rate of about 300,000 bales per year. The highest future prosperity of the South involves a continual, steady, but not excessive or spasmodic increase in the cotton crop, in close correspondence with the steady increase in the world's consumption of cotton.

But there is a further answer to this English charge that the prices and movement of American cotton are under the control of speculators; and the real purpose of this paper is to state this answer somewhat in detail, more particularly in connection with the new method of statistically measuring the annual cotton crop recently inaugurated by the United States census office. The purpose of this new inquiry is, in a word, to ascertain, by an actual count, the size of each year's crop, at the earliest possible date after it is harvested. An actual count of the cotton crop has never been made heretofore except at the ten year census periods. The data as to the volume of the annual cotton crop heretofore available have related solely to the commercial movement of the crop, and the figures of its actual size, from whatever source, have been estimates, based upon that commercial movement.

No commodity is followed so closely at every step in its progress from the seed planting to the mill door, as the American cotton crop, and the available supplies of no other crop are known with the accuracy which marks our information regarding cotton. The trade journals and the cotton exchanges expend thousands of dollars annually for information of the movement during each week in the year. Trained statisticians compile and weigh the figures for them. The great railroads are enlisted to return accurate records of shipments and bale weights. Beyond this, the statistical bureau of the United States Department of Agriculture maintains an organized force of correspondents throughout the cotton belt, reports from whom permit the forecasting of the coming crop from month to month, with an estimate of acreage, and a measurement of weather and other conditions, at each stage of cultivation. The Federal weather bureau supplements these monthly reports by weekly reports which photograph the condition of the crop with the fidelity of a camera. No child grows up at its mother's knee with a watchfulness more assiduous, more ceaseless, more solicitous, than marks the growth of every American cotton crop. Thus the power and the opportunity of the speculator are minimized at every point.

If, despite these safeguards, there frequently arises uncertainty as to what the crop is to be, such as is now witnessed, that uncertainty is due to nature's irregularities. No human being can tell a week in advance how rain or sunshine or the lack of the necessary supply of either, will affect the growing crop; and this uncertainty gives the cotton speculator his chief opportunity. There have occurred some remarkable errors in the estimates of the Southern cotton crop, the effect of which upon the market has been enormous.*

No one has ever claimed that the existing methods and machinery for ascertaining the cotton crop are perfect, or even approximately so. They are the best that can be devised in the absence of an actual count; but they are, in fact, only an elaborate and well based system of "intelligent guessing" as it was called by Senator TILLMAN.† It is proposed to substitute for this "intelligent guess," an actual count, obtained from the only source whence such a count can come quickly, — namely, the ginners of the cotton.

The Census Office was led to this experiment in the first instance, by the frequent complaints of the cotton growers

---

* Among the serious errors referred to may be mentioned the crop of 1899, which was by some of the commercial agents estimated at 2,000,000 bales in excess of what the commercial movement showed the crop to be. For the crop of 1901 an error both ways seems to have been committed. Basing estimates upon acreage and early weather conditions, the prospective yield in the spring was estimated as high as 12,000,000 bales, while under the scare of very unfavorable weather, conditions subsequent to the pitching of the crop, estimates were made as low as 9,000,000 bales.

Referring to this latter crop, Senator CULBERSON, in the debate on the Permanent Census Office bill in the United States Senate on February 17, 1902, said: "The price of cotton continually declined for months preceding the month of November. It was due to the estimates of the yield of cotton throughout the world and especially in the United States, made by other parties, and it was due in part, perhaps, to a failure to report accurately by the Agricultural Department, and during the month of November — I think it was November — the Department of Agriculture made an estimate of the yield of cotton in the United States and it was to such effect that instantly the price of cotton went up $2 a bale or about that."

† Congressional Record. February 15, 1902, page 1847.

themselves, that their crop was not fairly reported through the methods employed by the various commercial agencies, and that the government ought, in view of the importance of the cotton crop, to supply a check upon these commercial statistics, not an official estimate, such as the Agricultural Department makes, but an official count.

Some of the criticisms upon the commercial estimates may be summarized:

I. They measure the crop by its commercial movement only; and hence it is that not until the season has actually closed, upon September 1, a date arbitrarily fixed, is the volume of the crop harvested the previous fall definitely determined.

II. They take cognizance only of such part of each year's crop as actually comes to market, leaving as an unknown factor the quantity held back by growers and others. Mr. HESTER, of the New Orleans Cotton Exchange, estimated in 1900, 525,000 bales of old cotton unmarketed in 1898-9, and coming into sight for the first time in 1900. This was 4.7 per cent. of the crop reported for that year. Thus the commercial estimate is not an estimate of the crop of a given year, but may contain parts of the crop of two or three seasons, with no account whatever of the unmarketed crop of the season to which it relates.

III. They are open to the danger of constant duplication, which may occur in distinguishing the net receipts of the several ports — that is, the direct shipments from the interior — from the gross receipts, that is, shipments from one port to another port, and which have thus been twice reported.

IV. There is the same danger of duplication in the record of the "overland" movement. The machinery by which record is kept of all cotton moved by rail out of the cotton belt, and differentiated from the cotton so shipped to seaboard points, is extremely complicated.

V. A duplication occurs in the double reporting of cotton samples, commonly known as the "city crop", estimated to equal 150,000 bales in 1901.

VI. Again, the consumption of the Southern mills, another separate item in the commercial statistics, is necessarily an estimate, based upon the haphazard replies of the manufacturers.

VII. Finally the chief and the fatal weakness of the commercial system or method of estimating the cotton crop, lies in the fact that it supplies nothing tangible and definite, as to its actual volume, during and immediately subsequent to the harvesting, say from October to January; and these are the months when exact and trustworthy information is chiefly important to the grower and the legitimate consumer of cotton. This is the period during which the staple is passing from the growers' hands, and the value of his crop to him is determined. It makes no difference to him what rise or fall may occur thereafter; it benefits or hurts him none at all. It is at this critical time that the census reports will be made; and if they can be correctly made, they will disarm the speculator at the time when he can do the most mischief to both grower and manufacturer; and will become a permanent and most effective check against all commercial estimates. This check will not stop these estimates, but will compel the utmost caution on the part of the estimators.

These elements of uncertainty and delay in the commercial estimates are so numerous and so important, that ft appears safe to say that we can never be sure that the commercial figures of September 1, are within 300,000 to 600,000 bales of the actual crop.

These were the circumstances under which the census office was led to attempt, in 1900, an absolutely new experiment in the statistical measurement of the cotton crop. It had been urged by various parties, for many years, that it was possible to secure a quick and accurate count of the cotton crop through the agency of the ginners. Every pound of cotton must go through a gin before it can be commercially marketed. As a matter of fact practically the whole of the season's crop is found to have been thus cleansed and baled, by the average date of January 1, for the cotton belt.

In order to test the question, the census enumerators were given a special schedule in 1900, upon which they were instructed to report the number of bales of cotton, and their average weight, ginned in the previous year by every ginnery in their several districts. The result was remarkably satisfactory for a first attempt, and when the totals were subsequently compared with those of the Division of Agriculture, giving the returns of the planters of their actual growth, there was found to be a variation of less than two-tenths of one per cent.*

Encouraged by this success, the census office undertook in 1901 to make a similar count of the crop of that year, communicating directly with the ginners by mail. It was a hazardous experiment and but for the co-operation of the Postmaster General must have failed. By his direction every postmaster in the South became an agent through whom reports were obtained from practically every ginner who neglected to respond to the office circulars. This second report was thus completely suc-

* Bulletin 58 of the division of manufactures contains an exhibit of the quantity of cotton ginned in connection with the marketing of the crop of 1899. In comparing the data secured from the schedules of the division of agriculture with those of the division of manufactures there is found to be a very close general agreement, excepting for the small group of 23 counties in two states. They are: Adams, Attala, Bolivar, Claiborne, Itawamba, Kemper, Lafayette, Lauderdale, Neshoba, Oktibbeha, Sharkey, Tate, Tunica, Union, Warren, Washington, Wilkinson, and Yazoo in Mississippi; and Fayette, Hardeman, Lauderdale, Shelby, and Tipton in Tennessee.

Except for these 23 counties the returns from the two divisions, secured from two independent sources, show a variation of only 17,512 bales of 500 pounds. This variation is less than two-tenths of one per cent. In the 23 counties named there was a further variation of 71,442 bales, or a total of 88,954 bales, or 0.95 per cent. This small per cent. marks a greater degree of accuracy in both reports and a smaller variation than was deemed possible before the work of the enumeration of 1900. Evidence gathered by special investigation made by the division of agriculture in the 23 counties specifically referred to indicates that in those counties the division of manufactures failed to secure reports from all gins. No evidence of a similar character was discovered in any other part of the country. This fact may be considered almost conclusive proof that the system of securing cotton reports from the gins gives promise of furnishing statistics of cotton production with greater accuracy than has been attained by any other class of annual cotton statistics. In addition that system will enable the authorities in charge to publish such statistics much earlier than those secured by any other method.—*Report on Agriculture, Twelfth Census, Part II, page 412.*

cessful; and the reception accorded the statistics throughout the South was most flattering to all who were concerned in their preparation.*

A third report, equally successful, covering the crop of 1901, was published in the form of an advance bulletin on April 12, 1902, four and one-half months earlier than the public could be apprised of the size of the crop, measured by its commercial movement.

In the meanwhile Congress, impressed with the success of these two canvasses, had enacted a law establishing a permanent census office; and one section of this law instructed the office hereafter to make an annual canvass of the cotton crop through the ginners, with an additional provision for preliminary reports at brief intervals.

It ought to be possible, with the census machinery now organized, to trace and record practically every bale of cotton ginned in the cotton belt, and to publish the total by a date as early as March 1. The commercial movement of this crop can then be followed, in the manner now pursued, and in such a way

---

* It led to the adoption of commendatory resolutions by many organizations of cotton growers, of which the following, adopted by the Georgia Cotton Growers' Protective Association, in convention at Macon, Georgia, on July 12th, 1901, is a sample;

WHEREAS, It is vitally essential that some feasible method should be inaugurated for annually securing accurate statistics of the cotton crop as grown in the United States, by which the cotton growers may be able to defend themselves against the present detrimental tendencies of manipulated estimates: and

WHEREAS, The Director of the Twelfth United States Census has announced his willingness to make, annually, a complete canvass of the cotton ginned in the United States through the agency and co-operation of the ginners: and

WHEREAS, We believe that such an annual canvass will result in more accurate and satisfactory statistics of the actual cotton crop than have heretofore been obtained, and thereby eliminate all ficticious influences; therefore, be it

Resolved, That this convention heartily endorses the plan of Director MERRIAM for perfecting and modernizing the statistics of the cotton crop.

Resolved, further, That this convention urge the cotton ginners throughout the cotton belt, whose interests are identical with those of the grower, to co-operate with the Census Office in its effort to collect true annual statistics of the cotton crop, by making early and accurate replies to its request for information, to the end that the true interests of the producers may be properly promoted and protected.

that the cotton world will know from week to week, exactly what proportion of each year's crop is still in first hands. This is information never yet possessed, and of the highest economic importance. In a word, if the census office shall successfully achieve what it has set out to do, the statistical situation of cotton will be, for the first time, accurately known; and the opportunity for speculation and manipulation, which is only present when uncertainty exists, will have been reduced to a minimum.*

For the crop of 1902, the Census Office will issue three reports: The first two will cover the cotton ginned to and including October 18 and December 13 respectively; and the final report will cover the total quantity ginned from the growth of 1902.

Realizing that the collection of the data for these reports comes at a season when the ginner's time is greatly taxed, and appreciating the necessity of quick returns for hurried reports, the census office has located an agent in each county containing ten or more ginneries, who will visit each ginner and secure a report from him of the quantity of cotton ginned to the dates above named. In all cases where practicable, counties having less than ten ginneries have been combined with adjoining counties having more than ten; but where this cannot be done the office will depend upon the co-operation of the ginners to report by mail. Throughout the entire cotton belt there will be 626 of these local special agents of the Census Office. Six hundred and twenty-six counties have been individually organized and in combination therewith 59 more, making a total of 685 organized counties out of 770. Within this organized territory

* The cotton ginning inquiry is under the immediate supervision of Mr. DANIEL C. ROPER, Expert Special Agent, of South Carolina, who is peculiarly adapted by training and experience for the work. Mr. ROPER was born in 1867 on his father's cotton plantation in Marlboro County, South Carolina, and has been employed in every kind of work incident to the cultivation of cotton and its preparation for market. He is a graduate of Trinity College, North Carolina, class of 1888; has taught school; has represented his county in the lower house of the South Carolina legislature; and has been clerk of the United States Senate Committee on Inter-State Commerce. He was appointed a special agent of the census office in 1900.

99.3 per cent. of the crop of 1901 was grown. In the 85 unorganized counties there were for the crop of 1901 only 217 active ginneries and of a very small capacity, ginning only 63,482 bales, or seven-tenths of one per cent. of the crop grown in that year. The ginners in these unorganized counties will be furnished report blanks upon which they will be requested to make reports simultaneously with the local special agents in the organized counties. It is evident that the census office has a very complete organization which guarantees accurate results.

Whatever of error may have crept into the reports of the Census Office previously issued, through failure to keep in touch by mail with every ginnery throughout the country, will be corrected in the future, as these local special agents will be charged with the duty of reporting all establishments to the Census Office together with the quantity of cotton ginned by them. The Census Office has made diligent effort in its canvasses of the ginneries by mail for the past two crops to secure reports from each and every active cotton ginnery, but as these reports were made voluntarily by the ginners and local postmasters, there exists a possibility of error, measured on the part of the ginners by the degree of their willingness to report without remuneration, and on the part of the postmasters by their ability to secure the information. With the organized system under which the Census Office is to act in the future, these doubtful elements will be removed, as the local representatives of the Census Office will be paid to properly discharge their duties.

Following the successful launching of the actual annual count of the cotton crop, it will be possible for the Census Office to take a further advance step in line with the demand of the producers and manufacturers of cotton.

By a similar investigation, utilizing in the South the same field organization, it will be possible to ascertain, at given periods, the United States mills' takings, which, with the foreign shipments, will indicate the extent to which the supply is being drawn upon.

Thus it will be possible to know in the very early spring the

quantity of cotton grown in the previous year; the actual mill takings to given dates; the foreign shipments; and hence the surplus, as well as the actual quantity of cotton carried over from year to year.

I would not minimize the difficulties in the way, and I agree that it will take several years to thoroughly demonstrate the practicability of this plan of taking an annual census of the cotton crop. In 1900 the Census Office found that there were in existence in the cotton belt, 29,620 cotton ginning establishments, of which number 6,468 were public ginneries; 2,863 were operated for the single plantation only; and 20,289 were operated in connection with plantations, on public account. So rapid are the changes going on in these establishments, that the census list, which is constantly undergoing revision, averages a thousand changes every year.

The gin in the South is an important factor in the local industrialism, much the same as the grist mill or the saw mill; and indeed it is a common thing to find all three of these industries carried on under the same roof by one man. But the machinery for ginning cotton has of late been so greatly improved, and is now so comparatively expensive; and the cost of ginning is so much reduced by the newer processes and machinery, that we find a marked tendency toward the disappearance of the small gin, especially the plantation gin, and the concentration of the business in new and larger establishments, where large quantities of cotton are handled more expeditiously and more cheaply. It is the same evolution which is visible in all lines of manufacture, and it is progressing more rapidly in the cotton ginning business, perhaps, than in any other.

Thus we now have large companies controlling many ginneries in different sections. The American Cotton Company, owning the Bessonnette, or roundlap system, directly controls about one hundred ginneries and indirectly, by leasing baling machinery, some two hundred others. The Planters Compress Company, owning the system known as the Lowery bale press, control as many as one hundred ginneries. The combined outcome of the

plants operating the Bessonette presses for the crop of 1900 was 494,712 bales, and that of plants operating the Lowery system 273,380 bales. Furthermore, a large and increasing number of cotton ginneries is controlled by the Cottonseed Oil Companies and the Cotton Compress Associations. These consolidated conditions represent large investments of capital and consequent enlargement of plants. One of these large ginneries, yielding from 20 to 100 bales per day, takes the place of four to ten of the old plants. Economic conditions demand and improved machinery makes possible a continuation of this tendency toward consolidated methods of handling seed cotton. It is estimated that the supplanting of the old plantation ginnery by the larger public establishments has progressed so rapidly during the past five years that the number of small ginneries has decreased more than 50 per cent. It is clear that the number of ginneries will continue to decrease, and that the the facilities for perfect reports will increase as the business becomes more and more concentrated.

Thus the inquiry upon which the census office is now embarked, is of vital interest, not merely to the American manufacturer of cotton, but to the manufacturer and dealer all over the world. All possible assistance and encouragement ought therefore to be gladly rendered by the members of this body, by the cotton exchanges of the country, and by the cotton growers, whose stake in its success is perhaps the largest of all, since they are the men who suffer most from the manipulation of the market.

The PRESIDENT. Are there any questions to be asked Mr. NORTH?

Mr. WILLIAM D. HARTSHORNE. I would like to ask, Mr. President, if Mr. NORTH can explain that drop from 1840 to 1850 in the increase of production of cotton?

Mr. S. N. D. NORTH. I cannot explain it, Mr. HARTSHORNE. It seems to be in accordance with all the official figures, and I have looked everywhere for an explanation of it and can't find it. It is so much more marked than the drop between 1860 and 1870 that it attracts attention at once. Perhaps the most striking thing on that chart is the sudden development of the manufacture of jute, which does not seem to have been known much of any before the date upon which it first appears on that chart, but the growth of which has already surpassed the growth of flax. Another striking thing is the fact that the silk line on the scale that this chart is made appears to be almost uniform for over one hundred years, although its consumption has increased by quite a little amount.

Mr. WILLIAM D. HARTSHORNE. Mr. President, I would like to ask Mr. NORTH if there was not a considerable discrepancy last year between the government reports and the actual cotton crop, and if so, is there any reason assigned for it?

Mr. S. N. D. NORTH. There was a very marked discrepancy, Mr. President, a discrepancy which was most unfortunate and seriously effected the market. The explanation of it is simply this; No body of officials like the statisticians of the Department of Agriculture can make a guess in regard to the size of any crop at any time before that crop is harvested, or at any time after it is harvested, through its movement, until that movement is entirely closed, which can be relied upon as being an accurate guess. Nobody can make an accurate guess under any circumstances of a statistical fact, and I do not think it is possible to accomplish what seems on all accounts to be absolutely desira-

ble — that is, a quick and accurate knowledge of the volume of each crop — except by counting it bale by bale, and you can only count it by going to the ginners. We find the ginners keep very accurate records of the amount of cotton which they gin and of the average weight of their bales, and we have been surprised to see how willing and how glad they are to give the information. But now we propose to release them from all the burden of supplying this information by sending agents to them, and as I have stated in this paper, we have a corps of 650 agents very carefully selected without any reference to their politics, but picked more particularly with reference to their knowledge of the cotton crop, and these agents are to make to the census office three reports during each year, and on these reports the publication of the office is to be made. In my own mind I have no doubt that in the course of a very short time this census office count will take the place in the Cotton Exchanges and among the mill treasurers of the figures and estimates of the Agricultural Department and of the various exchanges.

Mr. THOMAS H. SMITH. When is the first one to be made?

Mr. S. N. D. NORTH. The first report will be made as of the 15th of October, the second report about January 1, and the final report, which will cover the entire crop, we hope to be able to publish by the first of March. The commercial year, as you all know, ends on the first of September, and we expect to very easily gain all the time between March 1st and September 1st in a definite ascertainment of the volume of the crop, and we expect not only to gain all that time, but we expect to get it right, which is quite as important.

The PRESIDENT. We will now proceed with the reading of the next paper, Preparation of Cotton for Carding and Spinning, Especially Egyptian Cotton, by Mr. JOHN J. CONNELL of Lowell.

PREPARATION OF COTTON FOR CARDING AND SPINNING; ESPECIALLY EGYPTIAN COTTON.

J. J. CONNELL, Lowell, Mass.

In preparing this paper my intention is to express an idea which I know is practical on each point, and I hope to get a discussion aroused that will give all present a chance to express their opinion, thus all profiting more than we would by listening to a long paper.

MIXING COTTON.

Cotton should be opened and mixed in large quantities, the larger the better, and should stand open at least three days, and more if possible, before using; by so doing you can get better and cleaner carding, more even humbers and better spinning than by using cotton right from the bale. Egyptian cotton should never be put in the feeder until it has been opened, or mixed, several days in a dry room. All kinds of cotton can be made at least one-half grade better by properly mixing and airing before using.

PICKERS AND LAPPERS.

When cotton is properly aired and loosened in the bins, the openers and lappers will take out more dirt and leaf and give cleaner yarn than it will when run from the bale. On 40-inch machines, I would run as follows:

Opener lap 10 oz. per yard,
Intermediate lap 11 oz. per yard,
Finisher lap 12 oz. per yard,

having the same number of openers, intermediates and finishers, arrange the speed of feed so as to get the same number of pounds through each machine. I consider 10,000 pounds per week a good production for a machine on ordinary work up to No. 40 yarn.

Most of us pay too little attention to the picker room, but if the best results are to be obtained, we must give it personal attention once in a while.

CARDING.

It is useless to go into detail on this subject, and I will only say that the 40-inch revolving flat card is the most popular and I believe it is the best. If you strip and oil them, clothe them tight, keep a good edge and set them right, you will never have any trouble with them, but I would like to know the results if every manager would go into his mill and weigh the sliver from twenty or more cards, as they are running and note the variation; I firmly believe most of you would be surprised, and I hope some one will suggest a way to get an even sliver.

DRAWING.

This is a most important point in a mill, to get even, smooth yarn; I believe in as many doublings as can be afforded, and at least three processes of drawing, and six in to one on each head.

SLUBBING.

This is where we put the first twist in the work, and run it single. I would have as short draft as possible, and be sure to put in twist enough in order not to strain it in the creels.

INTERMEDIATE.

Having a doubling here we can run a good draft, and should get very even work to go to the fine frames, or second intermediates, if we run four process work.

FINE FRAMES.

Good roving is hard to get, and there being so many different

ideas and so many different conditions, it is hard to fix a standard to go by, and lots of good work is spoiled in the roving frames. However, I think more can be gained by discussing this question than by listening to a long paper.

EGYPTIAN COTTON.

To begin with, I would like to ask if there is any specified rule for grading and sampling Egyptian cotton. Brown Egyptian is long staple and good quality; it is fine and silky, the diameter of fibres are very even, but the length is very uneven, in fact, all Egyptian cotton which I have seen, has more short undeveloped fibres than any other kind of cotton used.

Brown Egyptian cotton is a very nice cotton to run, and for soft twist hosiery is superior to any other kind; it cleans easily and runs well on every process, if the machinery is not overloaded.

Egyptian cotton requires about 10 per cent. more twist than American cotton of the same length of staple to get the same strength.

I trust this short paper will be sufficient to bring out a good discussion. I will answer as many questions as I can, and hope every one will try to express an opinion on some point, the most important of which, I think, is how many processes should we have in the card room, and can we get even work by dropping some of them.

I believe in trying to raise our Northern mills to a higher and better class of goods, leaving the cheaper and lower grades to our Southern friends who are making a good showing in this business.

The PRESIDENT. Gentlemen, have you any questions to ask or any suggestions to make in reference to this subject? The subject is so broad it may be rather difficult to start the discussion.

Mr. JOHN E. PREST. Mr. President, I would like to ask Mr. CONNELL if he would advise running a 12-ounce lap on a 45-inch card? He says he would run the finisher lap 12 ounces per yard. Does that mean for a 40-inch card, or 45-inch or 36-inch?

Mr. JOHN J. CONNELL. Forty-inch.

Mr. THOMAS H. SMITH. In regard to mixing, which Mr. CONNELL mentioned, I have found a great advantage in mixing the cotton a longer time than he specifies. I think a week or ten days instead of three days is better. We all know that you cannot buy any amount of cotton and find the staple equal; in one bale it will be a little longer than the other. If you mix the short bale with the long you cannot get the cotton to run evenly; it makes bad work. We have found a great advantage in doing this way: We have two bins, a No. 1 and a No. 2 bin. Every bale is sampled by the man who opens it and the sample is brought to me and I decide into which bin to put it. We run half and half on the pickers, two laps on the No. 1 and two on the No. 2. This gives you an absolute mixture. We find a very great advantage in the work in so doing.

Mr. JOHN J. CONNELL. What is the difference in the length of your staple between what you call the long and the short?

Mr. THOMAS HENRY SMITH. If you are using $1\frac{1}{4}$ staple you will find some bales which are $1\frac{3}{16}$ths and some which are nearly $1\frac{5}{16}$ths. Also some bales which are not as clean as they should be. We put the short staple and the dirty bales into No. 2 bin, in such proportions as we think best. This cotton is run through the opener alone, and this does not mix the clean

and dirty cotton. Then we run two laps from No. 1 bin and two from No. 2 on the finisher, and this gives you the same proportion of clean, and short, and long staple in your yarn. Of course the difference in staple, is only such as occurs in all cotton and we find this is the best way to deal with it.

Mr. JOHN J. CONNELL. I would have to say now that I should be positively opposed to mixing two kinds of cotton in the same run where there was a sixteenth inch difference in the staple. I should run them different. I should set my rolls for them right through the mills and if I were compelled to run cotton 1⅜ and then 1 5/16 I should run them in two different lots. I should run all the 1 5/16 together and all the 1⅛ together. I do not believe in mixing the staple at all, and I think it is a sad mistake when you do it. The length of the staple should be just as near even as it can be got and when a staple runs 1/16 to ⅛ of an inch different it ought to be thrown out and put into another run.

Mr. THOMAS H. SMITH. Don't you find any cotton you buy that varies that much?

Mr. JOHN J. CONNELL. We do, but I always make an effort to reject it and put it in with cotton of its proper length.

Mr. THOMAS H. SMITH. And then set all your rolls over again for it?

Mr. JOHN J. CONNELL. Whenever I change it.

Mr. THOMAS H. SMITH. It is too much trouble. We do not find any difficulty. There is a variation of 1/16 in the best cotton we buy; I find it so. We cannot get it all alike. Perhaps one reason why we get along better than some of our friends is that our spinning frames are made with self weighted middle and back top rolls. The American custom is to weight a middle roll; the English is a self weighted top roll. The ends

of the fibre are not held absolutely tight by the top roll, but it allows it to draw under a little bit. We do not find any difficulty in using cotton that way. We have to use it; we cannot set the rolls over continually. That is the best way I find to use the cotton which I get.

Mr. JOHN E. PREST. This question of cotton and the length of staple is quite a nice thing. I suppose we find in almost all mills, especially mills making print cloths and that class of goods, a variation of staple from 1 inch to 1⅛ inch and have to use it, as Mr. SMITH says.

Mr. THOMAS H. SMITH. Of course you do.

Mr. JOHN E. PREST. You cannot throw it out. There is not a mill in Fall River today but is using cotton that varies from 1 inch to 1⅛ inch in print cloths. They will get 1 inch and 1 1/16 inch out of the same bale. Sometimes you get 1⅛ inch. Now we have difficulty in running that. That is not the way to run; I agree with Mr. CONNELL in selecting a 1 inch and 1⅛ inch and running it separately. That is the best way to run a cotton mill. But you cannot always do as you want to. Of course you have to do as well as you can. As Mr. SMITH says, the English system uses self weighted rolls, the American system the three rolls weighted. We have all the different systems he speaks of; we have the self weighted middle roll, we have the weighted front roll and back roll and the middle roll not weighted at all. We have the self weighted back roll and the middle roll and the front roll weighted. Now I find where we get the difference in the staple with the weighted front roll and the back roll, the middle roll not weighted, which Mr. SMITH refers to, we get along very well with the various lengths of staple. Where we have the three rolls weighted, the American system, as Mr. SMITH calls it, and the variation in staple, we have more or less trouble with cockled yarn. We have all those difficulties to meet. Now then we get a bale and sample it and we say "That

is a good 1 1/16, perhaps 1 1/8 inch," and you find in that same bale some will go an inch, what are you going to do? Put off the cotton in something else, open another bale and set your machine all over? We cannot stop, we should never get anywhere. There are some of the difficulties. The best way is to get 1 1/16 inch and run 1 1/16 inch and to get 1 1/8 inch and run 1 1/8 inch, but how are you going to do it?

Mr. JOHN J. CONNELL. Mr. President, I do not mean by that statement that all your cotton, every fibre, should be 1 1/8; that is impossible. We all know that all cottons come to us with varying fibres from three-fourths or five-eighths inch to the full length that it is bought for and even a little better. But from stapling that cotton and taking the majority of the fibres it is decided by the people who staple it, the Cotton Exchange, or whoever they may be, that that cotton is 1 1/8. We are to assume from that grading that the majority of those fibres are 1 1/8 and we must set and adjust through our mill for that. Now if we are going to be technical in the matter and say that the inch fibre in there is going to damage us, why, we have no cotton and can get no cotton which is right, and for the sake of making thread and fine work we have to comb this cotton in order to get an even fibre for strength without bulk. And I still maintain what I said in the first place, that if you are running 1 1/8 cotton, sample all your cotton, allowing that the majority of it is 1 1/8 inch. If the majority is 1 1/16 it ought to be separated and run by itself.

The PRESIDENT. I think it may be that you gentlemen are talking at cross purposes. You seem to agree on the main point, that it is not well to run different lengths of staple. Mr. CONNELL takes a position that in running what is strictly 1 1/8 inch cotton he would do one thing; in running what is strictly 1 inch or 1 1/16 inch he would do another thing. Mr. PREST'S position that those variations in length of staple occur in the same bale is also correct. I think as a matter of fact that

Mr. CONNELL does exactly what Mr. PREST would do in running his mill. He buys his cotton and he puts it through as best he can; it is impossible to separate, as we all know, the long and the short stock in the same bales of cotton. Theoretically you seem to both agree. Can any one answer Mr. CONNELL'S question in reference to the specified rule for grading and sampling Egyptian cotton?

Mr. JOHN E. PREST. Mr. President, before I drop that matter of length of staple I would say that so far as the different length is concerned we have it adapted so we can run along, say $1\frac{1}{8}$ inch cotton, and a good full 1 inch and $1\frac{1}{16}$ — and we have our cotton selected and the $1\frac{1}{8}$ inch we lay one side, we run that separate from the other. We set our rolls and everything different. When we get any 1 inch cotton and strong $1\frac{1}{16}$, that is taken out and laid aside and taken to another mill. That is the system we adopt. But we find bales occasionally that are of all sorts of lengths. That is where the difficulty lies. In order to avoid that trouble we have certain mills with self weighted middle rolls, and some of the mills we run on $1\frac{3}{16}$ cotton, in others we run 1 inch and some others different lengths. Therefore we get along with the different lengths in that way. But we do find cotton in some bales of various lengths, and when we come to do our nice work and get this short stuff out, of course we use our combers and that gets the waste out.

The PRESIDENT. I notice Mr. EUGENE C. ANDRES in the back of the hall. As Mr. ANDRES is one of our experts on Egyptian cotton I thought possibly he might be willing to favor us with some remarks in reference to the grading and sampling of Egyptian cotton.

Mr. EUGENE C. ANDRES. All I can say in reference to Egyptian cotton is that manufacturers here do not know about the grading of it. If they would study it as they have studied American cotton, they would probably get at it. Egyptian cotton is a little more difficult to grade than American. I could

not suggest any way by which manufacturers could get at the grading except by practical experience. The grades of Egyptian are similar to those of American, and are put up according to the amount of leaf, dirt and short fibre they contain. But there is no way to get at this except through actual experience in the handling of it.

Mr. JOHN J. CONNELL. Mr. President, my purpose was to inquire how they do get at it in the present form. They give it to us in numbers, you know, at least I get hold of it by numbers and I was never able to know — I can tell by looking at it that it is either a middling or a strict good middling or something of the kind, but I was never able to find any form that they sent out showing that it was equal to American middling or strict middling, or any comparison or any guide to go by, and I have always raised that question wherever I could get a chance, and I hope at this place so near the Cotton Exchange to get an answer so that we can know whether we are buying strict middling, good middling, or strict good middling, so that we might make a comparative test and know where we were at.

Mr. ENGENE C. ANDRES. Egyptian cotton is not graded the same way American is; it is graded on a different standard. For instance, "Middling" would be about "Good fair Egyptian." We can always give you what the Egyptian Class is as compared with the American Class, but I am afraid manufacturers would not understand it. If I should offer you good fair Egytian I do not think you would know what I was talking about. Manufacturers are buying certain marks, and this is easier for them and easier for us. What they ought to do is to insist on buying on classification the same as they do on American cotton. If they do this they will gradually get on to it. Fine Egyptian is equal to about fair American grade. It is not much more difficult to grade than American cotton, as Egyptian grades are more alike.

Mr. JOHN J. CONNELL. Mr. President, I had hoped, in this

discussion, to get the ideas of some of the members present as to the processes in the card room. I have heard it said by a great many very practical men that we overworked the cotton and made too many processes, and at the same time never offering a suggestion of reducing the processes and giving us evener work. I think it is a good thing to talk over and get the ideas of everybody. If we can put cotton through the carding rooms in eleven processes and get it even, is there any way that we can put it through in nine, dropping two of those processes and still getting it as even? If there is we can reduce the cost. I know of two very popular mill men who make these claims, that they require only two processes of drawing and that they only need two processes of picking, and that they get just as even work as they do otherwise. But when you come to go to the mill and make an investigation and get into it, you find that they have so much unevenness that if you want to spin anything finer than 30s you could not spin it at all. I had hoped to get the ideas of a good many practical men on that point.

The PRESIDENT. Can any one help Mr. CONNELL on that point?

[No response.]

They evidently do not have those troubles, or else they have got over them.

We will now adjourn until 8.15 this evening.

THIRD SESSION.

WEDNESDAY EVENING, OCTOBER 1, 1902.

The Association met at 8.15 P. M., the President in the chair.

The PRESIDENT. Gentlemen, if you will come to order, please, we will proceed immediately to the reading of the papers. The first paper on the program this evening is Our Foreign Commerce in Cotton Goods, and I take great pleasure in introducing to you, Mr. O. P. AUSTIN, Chief of the Bureau of Statistics, Treasury Department, Washington, D. C.

OUR FOREIGN COMMERCE IN COTTON GOODS.

O. P. AUSTIN, Chief of Bureau of Statistics, Treasury Department, Washington, D. C.

I do not assume that I shall be able to offer any suggestions about cotton manufacturing which would be of value to you gentlemen, trained in the management and details of that industry. The representatives of the oldest and most advanced section of the cotton manufacturing industry of that country which produces three-fourths of the world's cotton and turns more of it into the manufactured article than does any other country in the world need no advice, and have no time to waste in listening to suggestions from a non-expert in those lines. I had thought on many occasions in my studies of our imports that I should like to suggest to the cotton manufacturers of the country that there is still a home market of 35 to 40 million dollars per annum which is being supplied by foreign manufacturers; but when I reflect that this amounts to less than ten per cent. of the value of the home consumption, and that the goods of which it is composed differ widely in requirements of machinery, workmen and conditions from the other 90 per cent. upon which your great factories are engaged, it seems quite unnecessary to urge upon you a fact with which you are already familiar and which you have doubtless well considered before determining to leave that field to the manufacturers of other countries. The cotton manufacturers of the United States have kept so well abreast of the demands of the great home market, and have kept the door so firmly closed against the keen rivalry of the world that their reasons for permitting an annual importation of from

$35,000,000 to $40,000,000 worth of cotton manufactures, differing widely from the bulk of their present productions, are doubtless good. Yet, as an earnest friend of the home industries of the country, I venture to express the hope that the inventive genius of the American, coupled with his energy and his interest in supplying the home market, may soon develop some method by which much of this $40,000,000 worth of cotton goods now brought from abroad may be produced at home to the profit of the American manufacturer and the American workman.

The chief subject to which I desire to call your attention, then, is the field that awaits you in the markets of other countries. You have, as I have already said, kept fully abreast of the great home market; but up to this time attempted comparatively little in the way of supplying the still greater foreign market. The population of the United States has doubled since 1870, and while the nominal value of the cotton manufactures of the country has only doubled during that time, according to the Census figures, the fact that values per yard of the principal manufactures are less than one-half those of 1870 indicates that the actual quantity of goods manufactured has fully quadrupled while population was only doubling, and this belief is supported by the fact that the quantity of raw cotton consumed by American mills has more than quadrupled in the same period.

This evidence of growth in production of cotton manufactures is so remarkable that I may be justified in a few words of details. The population of the United States in 1870 was, in round terms, 38 millions, and in 1900, 76 millions, an increase of 100 per cent. The value of the cotton manufactures of the United States was stated by the Census of 1880 at $177,000,000, and in 1900 at $339,000,000, an increase of practically 100 per cent. and an average of $4.65 per capita in 1870 and $4.46 per capita in 1900. But an examination of the tables of prices in 1870 and in 1900 shows that the average price of standard sheetings which was 14½ cents per yard in 1870 was but six cents per

yard in 1900, and that standard prints which were 12½ cents per yard in 1870 were but five cents per yard in 1900, and in other lines a somewhat similar reduction has occurred. Thus it may be assumed that although the Census figures showed an increase of but about 100 per cent. in value of cotton manufactures in 1900 as compared with 1870, the fact that prices per yard in 1900 were less than one-half those of 1870 justifies the assumption that the quantity of goods manufactured in 1900 is probably about four times that of 1870. This estimate is also supported by the fact that the quantity of cotton consumed by American mills in 1900 was more than four times as much as in 1870, the actual figures being: in 1870, 431 million pounds, and in 1900, 1,910 million pounds, or four and a half times as much in 1900 as in 1870. During that same period the imports of cotton manufactures grew from 23 million dollars in 1870 to 41 millions in 1900, or an increase in value of less than 80 per cent; while exports of cotton manufactures grew from less than four million dollars in 1870 to over 24 millions in 1900, an increase of more than 500 per cent.

The record of the cotton manufacturers of the United States in the last 30 years may, then, be summed up in the single statement that they have quadrupled production and home consumption while home population was doubling, that they have also reduced the per capita value of foreign goods consumed by the home population and have increased the value of their exportations 500 per cent.

But there are still other worlds to conquer, and that is the chief subject about which I want to talk to you on this occasion. You have taken care of your own home market and at the same time have indicated your power to extend your market abroad. That able and conscientious student of the cotton manufacturing industries of the country, EDWARD STANWOOD, with whose work you are all familiar, and who is personally known to many of you, states in his recent admirable report to the Census Office that the cotton manufacturers of the United States have during the past decade practiced for the first time the art of relieving the con-

gestions of the home market by distributing their surplus in the foreign markets, and I hope that the lesson which they have thus learned will prove the beginning of a systematic attempt to extend their sales abroad. The effect of the effort thus put forth in the last few years is shown in the fact that the exports of cotton manufactures in the fiscal year 1902 were not only the largest in the history of our export trade but were actually double those of 1896, three times those of 1885, four times those of 1876, and ten times the annual average from 1870 to 1875. Even this statement of the value of the exports does not fully tell the story of the actual growth, because of the fact that prices have so much fallen meantime that the figures of values today mean much greater quantities per dollar or per million dollars than did those of earlier years. The actual growth in exports can be better realized when we see that the number of yards of domestic cotton cloths exported in 1870 was 14 millions; in 1875, 29 millions; in 1885, 147 millions; in 1895, 184 millions; in 1899, 412 millions; and in 1902, 504 millions, or 36 times as much in 1902 as in 1870. This rapid growth of exports in recent years seems to justify the belief that American cottons are acceptable in the markets of the world and that the American manufacturer may, with the proper effort, obtain his share in the cotton markets of the world.

This brings us to the question of what the world's cotton markets now are, their location, value, and the class of goods which they consume, and the manufacturers who supply them. In general terms it may be said that the whole world is your field. Wherever civilized or semi-civilized man is found, there is a demand for cotton goods. But this very fact makes an accurate measurement of the world's market a difficult one. Of those articles which are only consumed by the more advanced nations, having a complete statistical record of their imports, we can accurately measure the consumption. We can trace, for example, practically every pound of raw cotton produced in the world, because it is exported, imported and consumed by nations whose statistical records supply precise information of

the quantities of this article passing through their ports or consumed by their mills. But the fact that a considerable share of the world's cotton manufactures is imported and consumed by countries which have no statistical record of their imports, makes a complete statement of the world's annual consumption of cotton manufactures impossible. It is practicable, however, to obtain figures of the imports of the principal countries, and these I have brought together for the latest available year. Taking first the grand divisions in the order of the magnitude of their imports of cotton manufactures, the figures stand:

Asia, first	220	million dollars.
Europe,	172	" "
North America,	69	" "
South America,	48	" "
Africa,	42	" "
Oceania,	22	" "
Total,	573	million dollars of recorded imports.

These statistics of imports are, as I have already said, necessarily incomplete, owing to the fact that a part of the cotton consumption of cotton goods is by countries which have no statistical record of imports, and this is plainly apparent in the fact that this total of 573 millions of exports falls about 50 million dollars below the recorded exportation of cotton goods by the great manufacturing nations, figures which I shall present later.

But it is with reference to countries, and their imports, that you are more especially concerned. Taking the more important consuming countries and arranging them in the order of magnitude of value of cotton goods imported, the figures stand:

India, first,	107	million dollars.
China, second,	73	" "
United States,	44	" "
Turkey,	30	" "
United Kingdom,	24	" "
Germany,	19	" "
Netherlands,	17	" "

Argentina,	16	million	dollars.
Dutch East Indies,	15	"	"
Egypt,	13	"	"
France,	13	"	"
Australia,	10	"	"
Brazil,	9	"	"
Philippine Islands,	9	"	"
Roumania,	9	"	"
Norway,	8	"	"
Canada,	7	"	"
Belgium,	7	"	"
Austria-Hungary,	7	"	"
Switzerland,	7	"	"
Algiers and Tunis,	7	"	"
Cuba,	6	"	"
Chili,	6	"	"
Mexico,	6	"	"
Cape of Good Hope,	5	"	"

These 25 countries which I have named imported 475 million dollars' worth of cotton goods in the latest year for which we have any available record, the remaining 100 millions of recorded imports being distributed in smaller sums among the other countries, and to this must be added 50 millions which is known to have been exported but which we are unable to trace because of the lack of statistical records in many of the consuming sections, chiefly located in Central America, Africa, Asia and Oceania.

While the first thing you want to know is the total value of the cotton imports of a country or continent, it is equally important to know the class of goods which make up that grand total; and while these details are too elaborate for presentation in a discussion of this character, it may be said in general terms that of the recorded cotton imports of the world, those of Asia are 50 million dollars value; cloths, 160 millions; and miscellaneous, 9 millions. Europe: yarns, 50 millions; cloths, 71 millions; miscellaneous, 50 millions. North America: yarns, one million; cloths, 24 millions; miscellaneous, 44 millions.

South America: yarns, one million; cloths, 37 millions; miscellaneous, nine millions. Africa: yarns, one million; cloths, 38 millions; miscellaneous, three millions. Oceania: yarns, one million; cloths, 16 millions; miscellaneous, four millions. All of these figures, with the details for each of the countries for which statistics are available are appended to this paper where they will be available for more detailed study, in case you desire to give them such examination.

I now come to an especially important question, one especially important to us as Americans, the source of supply of the cotton goods imported by the consuming world. MULHALL estimated in 1896 that the total value of the cotton goods manufactured in the world was 1,600 million dollars. The records of exportation of cotton goods by the manufacturing nations show total exports in 1901 of 625 million dollars value, and it therefore appears that about one-third of the total cotton manufactures of the world enter into international commerce. The detailed record of the exports of cotton manufactures in 1901 is: Europe, 545 million dollars; Asia, 49 millions; North America, 31 millions; and taking the record of the exports by principal countries, it stands: United Kingdom, 358 millions; Germany, 59 millions; France, 36 millions; India, 35 millions; United States, 32 millions, or less than one-tenth as much as the United Kingdom; Switzerland, 29 millions; Netherlands, 16 millions; Italy, 14 millions; Japan, 13 millions; Russia, eight millions; Belgium, seven millions; Austria-Hungary, six millions; and Spain, five millions. Of the 358 million dollars worth exported by the United Kingdom, 38 millions was in the form of yarn, 275 millions cloth and 45 millions miscellaneous; and of the total cotton exports of all manufacturing countries, practically 100 millions is in the form of yarns, 400 millions in cloths and 127 millions in miscellaneous manufactures.

The fact which has most impressed me in the study of these figures is, that practically all of the manufactured cotton goods exported by the world are now made in and exported from countries which produce no cotton, but which buy nearly all of

VALUE OF COTTON MANUFACTURES IMPORTED INTO THE PRINCIPAL COUNTRIES OF THE WORLD.

COUNTRIES.		Yarns.	Cloths.	Misc.	Total.
EUROPE:					
Austria, Hungary,	1901	$4,622,000	$1,172,000	$1,401,000	$7,195,000
Belgium,	1901	841,000	3,237,000	3,518,000	7,596,000
Bulgaria,	1901	962,181	1,057,091	193,326	2,212,598
Cyprus,	1899	89,986	143,781	. . . . .	233,767
Denmark,	1900	1,398,000	2,549,900	687,000	4,634,900
France,	1901	3,840,000	1,655,000	7,650,000	13,145,000
Germany,	1901	11,557,000	3,548,000	3,930,000	19,035,000
Greece,	1901	236,101	1,437,532	375.640	2,049,273
Italy,	1901	297,167	1,905,756	1,352,704	3,555,627
Netherlands,	1901	10,965,000	5,675,000	380,000	17,020,000
Portugal,	1900	441.000	2,362,000	399,000	3,202,000
Roumania,	1899	1,925,000	7,237,000	. . . .	9,162,000
Russia,	1901	2,434,000	1,637,000	1,134,000	5,205,000
Finland,	1900	233,600	953,447	36,963	1,224,010
Servia,	1900	390,921	511,755	131,100	1,033,776
Spain,	1901	626,541	842,422	435,145	1,904,108
Sweden,	1900	745,300	1,471,900	930,000	3,147,200
Norway,	1900	1,752,700	1,429,800	5,365,900	8,548,400
Switzerland,	1901	1,635,980	4,229,788	1,366,950	7,232,718
Turkey,	*1900–01	3,649,985	24,352,114	2,226,119	30,228,218
United Kingdom,	1901	1,076,523	4,468,362	18,783,819	24,328,704
Total,		$49,719,985	$71,876,648	$50,296,666	$171,893,299
NORTH AMERICA:					
Barbados, Bermuda and Br. Hondurus,	1899	. . . . .	$204,083	$44,782	$248,865
Canada,	1901	$192,760	4,308,632	2,659,929	7,161,321
Central American Republics,	*1900–01	249,093	2,996,921	949,808	4,195,822
Cuba,	1901	. . . . .	4,225,930	1,844,124	6,079,054
Jamaica,	1900	. . . . .	1,348,658	. . . . .	1,348,658
Mexico,	1901	910,548	3,254,292	1,248,772	5,413,612
Martinique and Guadeloupe,	1898	15,179	399,947	13,963	429,089
St. Pierre and Miquelon,	1898	2,089	37,678	34,906	74,673
United States,	1902	. . . . .	7,020,779	37,439,347	44,460,126
Total,		$1,369,669	$23,796,920	$44,235,631	$69,402,220
SOUTH AMERICA:					
Argentina,	1901	$757.359	$11,788,870	$3,776.355	$16,322,584
Bolivia, Ecuador and Peru,	*1900–01	34,500	3,513,872	769,714	4,318,086
Brazil,	*1900–01	565,740	6,077,582	2,200,326	8,843,648
Chili,	1900	. . . . .	5,703,215	1,016,878	6,720,093
Columbia and other So. Am. Countries,	*1901	29,399	7,556,185	877,527	8,463,111
French Guiana,	1898	3,830	108,632	145,329	257,791
Uruguay,	1901	. . . . .	2,302,922	570,615	2,873,537
Total,		$1,390,828	$37,051,278	$9,356,744	$47,798,850
ASIA:					
British India,	1901–02	$8,587,837	$94,577,595	$3,556,789	$106,722,221
Ceylon,	1900	. . . . .	2,568,787	. . . . .	2,568,787
Straits Settlements,	1899	972,924	6,269,792	2,112,294	9,355,010
Other British Colonies in Asia,	1899	. . . . .	600,527	3,689	604,216
China,	1901	35,741,273	35,454,471	1,977,732	73,173,476
French India,	1898	. . . . .	119,197	. . . . .	119,197
French Indo-China,	1898	1,733,728	1,915,742	200,379	3,849,849
Dutch E. Indies,	1900	1,286,000	14,351,000	. . . . .	15,637,000
Japan,	1901	2,427,122	1,861,156	550,909	4,839,187
Siam,	1901	. . . . .	2,310,579	759,384	3,069,963
Total,		$50,748,884	$160,028,846	$9,161,176	$219,938,906
OCEANICA:					
Australian Commonwealth,	1899–1900	. . . . .	$8,117,103	$1,497,106	$9,614,209
New Zealand,	1900	. . . . .	989,535	1,793,631	2,783,166
Phillipines,	1900–01	$1,160,583	7,033,825	1,234,674	9,429,082
Total,		$1,160,583	$16,140,463	$4,525,411	$21,826,457
AFRICA:					
Egypt,	1901	$1,215,741	$12,104,418	$232,350	$13,552,509
Algeria and Tunis,	*1900	. . . . .	7,347,000	. . . . .	7,347,000
Madagascar and other French Colonies,	1898	116,232	4,919,274	110,425	5,145,931
Cape of Good Hope,	1900	. . . . .	2,894,044	2,142,569	5,036,613
Other British Colonies in Africa,	1899–1900	. . . . .	9,088,169	211,980	9,300,149
German Africa,	1900–01	. . . . .	1,848,100	. . . . .	1,848,100
Total,		$1,331,973	$38,201,005	$2,697,324	$42,230,302
Grand Total,		$105,721,922	$347,095,160	$120,272,952	$573,090,034

*Exports of cotton goods from principal European countries and the United States.

EXPORTS OF COTTON MANUFACTURES FROM THE PRINCIPAL COUNTRIES OF THE WORLD.

COUNTRIES.		Yarns.	Cloths.	Misc.	Total.
EUROPE:					
Austria, Hungary,	1901	$1,051,000	$2,115,000	$2,963,000	$6,130,000
Belgium,	1901	1,173,000	1,288,000	4,607,000	7,068,000
Bulgaria,	1901	. . . . .	. . . . .	. . . . .	. . . . .
Denmark,	1900	7,100	29,000	. . . . .	36,100
France,	1901	878,000	20,825,000	14,575,000	36,278,000
Germany,	1901	6,792,000	21,357,000	30,952,000	59,101,000
Greece,	1901	26,520	17,985	. . . . .	44,524
Italy,	1901	3,560,039	8,242,708	2,455,927	14,258,674
Netherlands,	1901	1,694,000	14,040,000	. . . . .	15,734,000
Portugal,	1900	. . . . .	1,993,000	246,000	2,239,000
Russia,	1901	. . . . .	8,716,000	. . . . .	8,716,000
Finland,	1900	51,454	725,311	. . . . .	776,765
Spain,	1901	. . . . .	5,597,222	. . . . .	5,597,222
Sweden,	1900	929,700	114,900	. . . . .	1,044,600
Norway,	1900	5,900	72,700	. . . . .	78,600
Switzerland,	1901	3,285,113	5,463,422	20,115,129	28,863,664
United Kingdom,	1901	38,820,226	274,965,445	44,805,369	358,591,040
Total,		$58,275,071	$365,562,693	$120,719,425	$544,557,189
NORTH AMERICA:					
Canada,	1901	. . . . .	$378,095	$126,405	$504,500
Mexico,	1901	. . . . .	. . . . .	. . . . .	. . . . .
United States,	1902	. . . . .	25,861,196	6,247,166	32,108,362
Total,		. . . . .	$26,239,291	$6,373,371	$32,612,862
ASIA:					
British E. Indies,	1901–2	$30,226,464	$4,624,791	$399,503	$35,250,658
Japan,	1901	10,253,452	2,855,307	539,668	13,648,507
Total,		$40,479,916	$7,480,178	$930,071	$48,898,165
Grand Total,		$98,754,987	$399,282,162	$128,032,067	$626,069,216

EXPORTS OF COTTON MANUFACTURES IN 1901, BY GRAND DIVISIONS.

(In millions of dollars.)

Europe. 544.

Asia. 48.

North America. 32.

SHARE WHICH CLOTHS, YARNS, AND MISCELLANEOUS GOODS FORMED, RESPECTIVELY, OF THE TOTAL EXPORTATION OF COTTON MANUFACTURES OF THE WORLD IN 1901.

(In millions of dollars.)

Cloths. 400.

Miscellaneous. 127.

Yarn. 100.

RECORDED IMPORTS OF COTTON MANUFACTURES IN 1901 BY GRAND DIVISIONS.

(In millions of dollars.)

Asia. 220.

Europe. 172.

North America. 70.

South America. 47.

Africa. 42.

Oceania. 21.

EXPORTS OF COTTON MANUFACTURES FROM THE UNITED STATES, 1870, 1885, 1902.

(In millions of dollars.)

1870. 3.8

1885. 11.8

1902. 32.1

WORLD'S EXPORTS OF COTTON MANUFACTURES IN 1901, BY PRINCIPAL COUNTRIES.

(In millions of dollars.)

United Kingdom, 358

Germany. 59

France. 36

India. 35

United States. 32

All other countries. 105

EXPORTS OF COTTON CLOTHS FROM THE UNITED STATES, 1870, 1885, 1902.

(In millions of yards.)

1870. 14.4

1885. 147.5

1902. 504.7

PRODUCTION OF COTTON BY GRAND DIVISIONS.

(In bales of 500 lbs.)

North America. 10,078,000

Asia. 3,500,000

Africa. 1,070,000

South America. 110,000

NOTE. — Figures of production of cotton by grand divisions are from latest available information.

their raw cotton from us. The total exports of cotton cloths amount to 400 million dollars annually and of this 365 millions, a million dollars a day, is sent from Europe, which produces no cotton, and but 26 million dollars' worth from the country which produces three-fourths of the cotton of the world — the United States.

Of the 127 million dollars' worth of miscellaneous cotton manufactures exported 120 million dollars' worth is from Europe and but six millions from the United States. Of the 100 million dollars' worth of yarn, 58 millions are from Europe, 10 millions from Japan, which produces no cotton of consequence, 30 millions from India, and none from the United States. Thus, of the 625 million dollars' worth of cotton manufactures entering into international commerce, 544 millions is from Europe, which imports all of the cotton which it utilizes in this manufacture, and only 31 millions from the country which produces about three-fourths of the cotton of the world, the United States.

These facts are not altogether pleasant to contemplate, especially in this country which not only produces three-fourths of the cotton of the world, but prides itself upon having the greatest manufacturing system, the best machinery, the most skilful workmen, the largest capital for investment in great productive industries, and the most energetic business men of the world. We have steadily increased our production of raw cotton from less than one million bales in 1830 to an average of about 10 million bales per annum in recent years. At the beginning of the century we produced, according to MULHALL, less than one-tenth of the cotton of the world; in 1820 about one-fourth; in 1831 less than one-half; from 1850 to 1880 (excepting the war period) about two-thirds; and now about three-fourths of the entire supply of the raw cotton of the world. Mr. WATKINS, the cotton expert of the Department of Agriculture, estimates that the United States now supplies 85 per cent. of the commercial cotton of the world. Yet, in the midst of this great production and an unparalleled growth in our manufacturing industries, we have simply transformed about one-third of our crop into manufac-

tures to supply our own people and have left to the other countries which produce no cotton the profitable work of manufacturing the other two-thirds of our product and distributing it among the nations of the world.

I say all this, not by way of criticism, but because I believe the time has now come when you will be able to begin the manufacture of at least a much larger share of our great cotton supply before distributing it to the world; and I think I am justified in this conclusion from a study of the cotton manufacturing industries of the world during recent years.

The great cotton manufacturing sections of the world are, as you of course know, the United Kingdom, the continent of Europe, the United States, India and Japan. Two of these, the United States and India, produce the cotton which they manufacture; the others, the United Kingdom, the continent of Europe and Japan, import all of their cotton. A careful study of the cotton consumption of these sections for a term of years justifies, it seems to me, the assertion that the movement of the manufacturing industry is now toward the sections in which the cotton is produced. In 1890 the United Kingdom manufactured 3,227,000 bales of cotton and the United States manufactured but 2,189,000 bales, or about 66 per cent. of the quantity manufactured by the United Kingdom. In 1901 the United Kingdom manufactured 3,269,000 bales and the United States 3,435,000 bales, the United States actually exceeding the United Kingdom in the quantity of cotton manufactured.

In 1890 the number of spindles in the United Kingdom was 43,750,000, and in the United States 14,405,000, or about 33 per cent. of the number in the United Kingdom.

In 1901 the number of spindles in the United Kingdom was 46,100,000 and in the United States 20,000,000, or 43 per cent. of the number in the United Kingdom.

The number of spindles in the United Kingdom and the continent of Europe combined increased 16 per cent. from 1890 to 1901; those of the United States increased 40 per cent., and those of India 53 per cent.

The consumption of cotton in the United Kingdom and on the continent of Europe increased 18 per cent. from 1890 to 1901; that of the United States 57 per cent., and that of India from 1890 to 1899 (the year preceding the drouth and famine) increased 66 per cent.

These facts, it seems to me, justify the belief that the cotton manufacturing industry is gradually moving toward the cotton producing sections of the world and that we may expect that the United States will from this time forward not only increase her percentage in the cotton manufacturing industry of the world but soon become an important factor in supplying the world with the manufactures which are now supplied by the countries to which we furnish the raw material instead of manufacturing it ourselves.

And now one word as to the "Eastern Peril," so called, the supposed danger that the cotton manufacturers of the United States and Europe may be overwhelmed when the cheap labor of the Orient shall be utilized in the manufacture of cotton goods. This is a serious question and must be seriously considered. With 400 million people in China, 300 million in India, and 100 million in Japan and Oceania, most of them willing and anxious to work for a small fraction of the wages paid in the United States or even in the European countries, the thought of what might be accomplished by combining this cheap labor with modern machinery seems serious, not to say alarming. But we must not forget that increased earnings bring increased wants among the Orientals as well as others. I find that during the very period in which the cotton manufacturing industry has been growing with such rapid strides in Japan and India the importations of cotton goods have actually increased, rather than decreased. From 1890 to 1901 the number of cotton spindles in Japan increased from 377,895 to 1,234,976, the rate of wages paid to workmen in the cotton mills fully doubled, but despite this large manufacture of cottons at home the importation of cotton goods actually increased.

The average annual value of cotton tissues imported into

Japan in the five-year period ending with 1890 was $2,985,634, and during the five-year period ending with 1901 the average annual value of cotton tissues imported was $5,834,667, or practically double the annual average from 1885 to 1890. In India a somewhat similar condition is apparent. The number of cotton spindles increased from 1,400,000 in 1880 to 5,008,000 in 1901, yet the average annual importations of cotton tissues in the five years ending with 1880 was $78,649,004 and in the five years ending with 1901 was $81,211,203, and last year was 107 millions.

Thus in both Japan and India the value of importations of cotton manufactures is actually greater now than in the early period of their cotton manufacturing industry, while the fact that prices have materially fallen meantime indicates that the figures of value here quoted represent an even greater percentage of increase in quantity. It is true that in both India and Japan there has been a decrease in the importation of cotton yarns, but it is equally true that in both cases there has been an actual increase in the importation of the finished cotton goods during the very period in which the home manufacture has so greatly increased.

While it is possible that the manufacturing industries of the Oriental countries may, at some distant time, be able to meet a large share of the home demands, the enormous number of people to be there supplied — half the population of the world — and the fact that Asia and Oceania now take nearly one half of the world's cotton exports, suggests that the Orient will, for many years at least, remain the most important market for cotton goods, and especially so to the manufacturers of the United States, whose goods are rapidly growing in favor with them.

It is not necessary that I extend this discussion by telling you that your best market at the present time is in China, or that American cottons are gaining ground in that country over those from Europe, or that China is the second largest purchaser of cotton goods in the world. You know all that. You know

that our exports of cotton goods to China have grown from less than four million dollars in 1892 to over 16 million dollars in 1902, and that more than half of our exports of cotton goods last fiscal year went to China. You know that the popularity of American cotton cloth in that country is such that it is rapidly taking the place of English and other European cloths, and that our exports of cotton cloth to China have grown from 66 million yards in 1892 to 335 millions in 1902, a gain of 400 per cent. in a decade, and that 66 per cent. of our total exportation of cotton cloths last year went to China alone. These facts have been so often told that you are perfectly familiar with them, and, important as they are, I can add nothing to their importance or to your information by repeating them on this occasion.

"King Cotton" is steadily extending his domain in the world of textile manufacture and textile consumption. That greatest producer of textiles, Great Britain, whose manufactures are now an accurate index of the demands of the consuming world, utilized in 1800 but one-fifth as much cotton as she did of flax and wool combined. By 1830 the cotton used was two-thirds as much as the flax and wool; in 1860 it was twice as much, and in 1900 nearly two and one-half times as much as the flax and wool combined. Her consumption of flax increased during the century from 108 million pounds to 215 millions; that of wool, from 100 millions to 500 millions, and that of cotton from 42 millions to 1,600 millions; an increase of 100 per cent. for flax, 400 per cent. for wool, and nearly 4,000 per cent. for cotton. Even in this recent period from 1870 to 1900 the wool entering into the international commerce of the world increased, according to Mr. WATKINS, of the Department of Agriculture, from 1,295 million pounds to 2,685 million pounds, an increase of 107 per cent., while the cotton increased from 2,483 million pounds to 6,796 million pounds, an increase of 174 per cent., thus indicating the steady gain which cotton is making in supplying the textiles of the world.

Five great factors enter into the production of cotton manufactures: raw material, power, machinery, capital and labor.

What country produces the most and best cotton in the world? The United States. What country produces the most and cheapest coal for production of power? The United States. What country has the best and most ingenious and effective machinery of the world? The United States. What country has now the most capital available for use in manufacturing? The United States. What country has the most skilful, faithful and energetic workmen of the world? The United States.

What country then should become the chief seat of the cotton manufacturing industry, not alone for its own people but for supplying the manufactured article to all the world? With full confidence in the productive ability of our agriculturists, the ingenuity of our inventors, the faithfulness and application of our workmen and the integrity and energy of our manufacturers and business men, I again answer, the United States.

The PRESIDENT. Gentlemen, in thanking Mr. AUSTIN for this valuable paper I think that I should congratulate ourselves on having such a contribution for our Transactions. No doubt Mr. AUSTIN will be very glad to answer any questions.

Mr. O. P. AUSTIN. Yes, I will be very glad, Mr. President, if I can answer any questions that may be asked or have any exchange of views upon the subjects. I felt all the time that I wanted this to be a conversation and a consultation rather than a speech, and I shall be very glad to hear what members of the Association have to suggest upon the subject, if it is in order; I don't know what your custom is.

The PRESIDENT. I think, sir, you have covered the ground thoroughly. If there is nothing further to be said we will proceed with the reading of the next paper, Mill Construction on the Continuous Skeleton System, Mr. SANFORD E. LORING, Syracuse, N. Y.

*MILL CONSTRUCTION ON THE CONTINUOUS SKELETON SYSTEM.

S. E. LORING, Syracuse, New York.

I purpose to try to illustrate some of the benefits which can be secured by the application of the continuous skeleton system of construction to cotton mill buildings.

During a recent visit to cotton mills in Birmingham and Huntsville, I asked this question: "What do you need in your mills that you haven't got and would have if you could get?" The answers were, "Less vibration and more stability both horizontal and vertical." This vertical movement was shown by very active vertical movements in both floors and roofs. Second, higher stories to help diffuse both light and air, and more light to diffuse.

I will show you that these important wants can be supplied by the use of a continuous skeleton system of built up wood construction. The order in which machinery should be placed, and the room it should occupy, is the work of the mechanical engineer, and I leave it with him; and will only undertake to show you how *his* work can be housed, how these special wants can be supplied and greater stability and more light can be secured.

In a brief talk before you last April, I called your attention to

---

* For other papers on the subject of Mill Construction reference is made to the Transactions of the Association in papers by EDWARD ATKINSON, Vol. 27, page 119; CHARLES T. MAIN, Vol. 41, page 60; EDWARD ATKINSON, Vol. 55, page 61; STEPHEN GREENE, Vol. 63, page 128; O. B. PARKER, Vol. 64, page 282.

the relative vertical stability of a skeleton built up wood construction made by spiking together dry planks and scantling and so arranged that both vertical and horizontal lines were made continuous; and (in the sense of joints that do not cut entirely through beams or posts at one point) jointless throughout. The entire frame is substantially a unit or monolithic in its character, and of the same type of construction as the metallic skeleton frames that during the past eighteen years have been and are being built in this and other lands.

This skeleton principle since its recent practical application to building construction, has made a radical change in the usual order of building and has taught us how to secure vertical stability, by substituting (abcve the foundation or grade lines) for heavy walls of masonry or brickwork, metals and other materials. These piles of masonry or brick we had come (from force of habit largely), to consider an essential element of stability in building. The use of steel skeleton buildings has helped us to change our views. As both vertical and horizontal stability, with greater economy and practical safety from fire is needed in erecting cotton mill buildings, I will show you that this increased vertical and horizontal stability has been secured by the use of a continuous skeleton frame, built up of dry plank and scantlings. I emphasize the word dry, because dry wood has been found to be twice as strong as green, and built up timbers of dry planks *can be so constructed* as to be as strong or stronger than green or even dry timbers of the same size. The published records and some unpublished records in my possession by the late Prof. J. B. JOHNSON and others, prove the truth of these statements.

To illustrate this matter of stability, I call attention to several views of a seven-story tower built in Syracuse, N. Y. from plans which I made and developed on the lines herein referred to. It was jacketed with heavy walls and piers or buttresses of brickwork in obedience to the requirements of the Syracuse building law. This law has no provisions crediting any skeleton system of building with the extra vertical stability, or any other

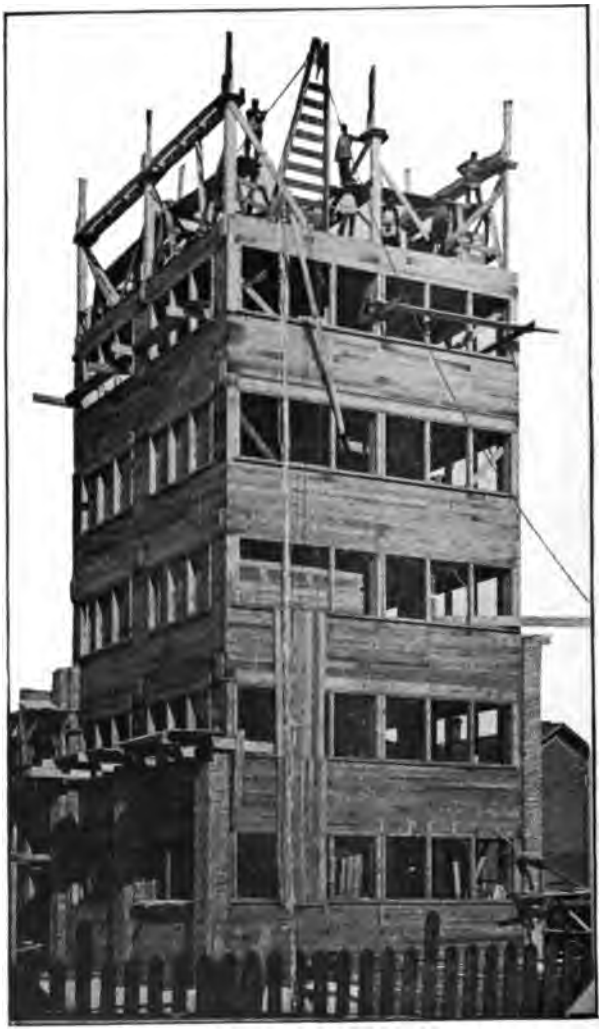


FIGURE 1.

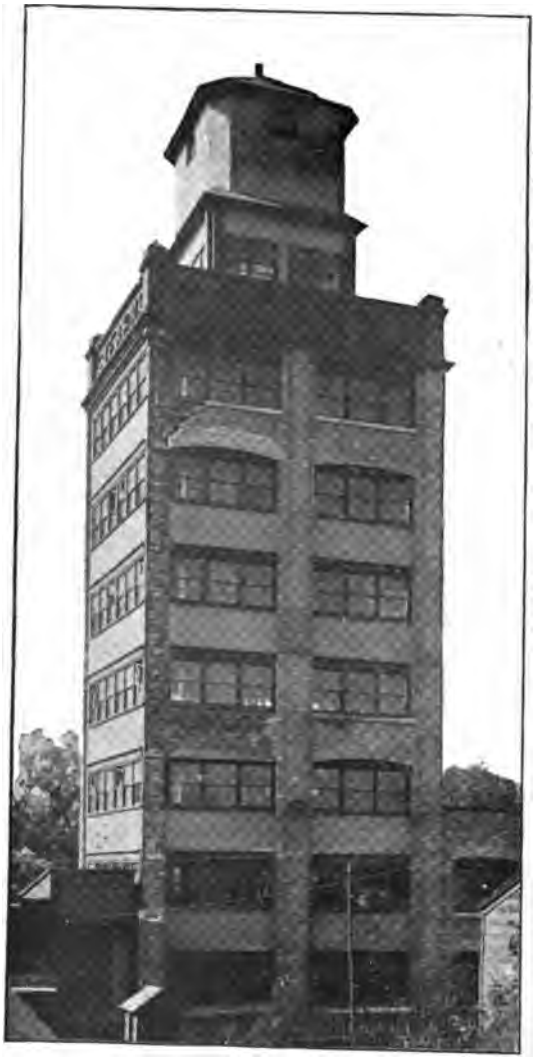


FIGURE 2.

of many added values that such systems provide and that warrant reductions in size of all interior partition or external enclosing walls. A few years ago this seven-story tower building stood in the path of a tornado that uprooted trees, unroofed and blew down the walls of a large number of buildings in its immediate vicinity and in other parts of the city of Syracuse. This storm has enabled the tower to give us a practical demonstration of the vertical stability of its built up wood skeleton frame to which I am pleased to call your attention. While a massive heavy corner pier or buttress of brick work 60 feet in length and two adjoining 13-inch brick panels were blown off from the building, and carried ten feet forward in falling on to the adjoining lot, the skeleton wood frame within these heavy walls withstood the shock with so little movement, that on three sides not a light of glass was damaged. The order in which it was built, is shown by the view marked Figure 1, where you will notice the continuous skeleton wood frame of built up plankings is being erected far in advance of the enclosing walls of brick work. Some of those now present may recall the view Figure 2 as having been used in a former meeting (where power stacks was the topic being considered), to illustrate the probable force of the tornado which this skeleton power stack had successfully resisted.

These views were made from photographs taken a few hours after the storm. This one shows the east side of tower from which a mass of brick work was torn by the wind.

The view marked Figure 3 shows the opposite side with the skeleton power stack in the distance. The damage to brickwork on this side was not so great and further illustrates the relative instability of brick walls and piers during tornado conditions and the greater stability of a skeleton wood frame which these brick walls then depended upon for vertical support. I hope that these practical demonstrations of the stability of work of this class in active use will satisfy you that I have good grounds for advising you to use these methods of building; and that the desired extra stability and freedom from excessive vibrations which is needed in cotton mills can be secured by such use.

FIGURE 3.

FIGURE 4.

I have been told that in ordinary mill constructions it is impractical to run a large body of weaving looms in the upper story of a three or four story mill.

The view marked Figure 4 is enlarged from a photograph showing wire weaving machinery, which for many months was run in the fourth story of a relatively inferior type of this skeleton built up wood construction, under a series of vertical saw tooth lights. No excessive vibrations were noted on any of the floors or roof of this building. I call it a relatively inferior type because it was a mixed construction of solid and built up timbers, which is not as substantial as the types of building I have since designed and now advise clients to use.

In view of these practical illustrations and this experience one can consistently advise mill owners to put these vertical saw tooth lights above the upper stories of this type of buildings and if the location is convenient do weaving or any work that requires extraordinary stability and extraordinary light on this upper floor. Both can be secured by the use of this method of building combined with this well known form of lighting through flat roofs.

Let us now take up the question of extra light and practically illustrate the possibilities in this direction, as well as the question of stability. I call your attention to views of four, six and eight-story buildings of this built up skelton type, in various stages of construction that have been in use several years. This four-story building, Figure 5, is to illustrate stability and extraordinary light. This six-story building, Figure 6, the same. This eight-story building, Figure 7, covers the question of stability as does this seven-story tower building, Figure 8, which was built for the same class of work as Figures 1, 2 and 3.

These views, with what has been said, illustrate all these points. I will only remind you that since we carry the entire floor loads upon continuous posts that form parts of this skeleton frame and provide vertical stability, that the entire wall surface between these posts could be filled with sash and glass, and all the light secured that this entire area could provide. The blank

FIGURE 5.

FIGURE 6.

walls that appear as piers between these openings and in front of the post members of this skeleton supporting frame can be used for heating and ventilating flues. That is the best use that can be made of them. While such a pier seems to be a large and massive brick buttress, it is as a matter of fact a group of vent or heating flues through which pipes may communicate with the different stories of the building. These piers are supported by the skeleton frame vertically, and little brick work is required to secure stability.

To recall these various matters and indicate one way in which by the use of this skeleton system these elements of stability and light can be grouped, I have made a sketch, Figure 9, in which I have shown the increased light and the heat and vent flues that can be provided where the skeleton frame furnishes the required stability, and massive brick walls and piers are not needed, either to support floor girders or resist the vibration of wind or machinery. They indicate parts of a cotton mill building that could be made by using this continuous skeleton built up timber frame.

With proper details, this built up construction can be made to provide the extraordinary wants of the cotton mill men to whom I referred in the beginning of this talk. The increased stability and added light, which they desired, can be secured and all the requirements provided by the current method of cotton mill construction, in which heavy and usually green timbers are used, and heavy walls and piers are built to support the floor timbers and provide a mass of dead load that can resist vibrations caused by wind and machinery.

These vibrations in this continuous skeleton type of construction are cared for in an entirely different way. The junction of the vertical post lines and the girders or beams where one or both are used is rigid and continuous. The vibration of any one section in a mill is received by this rigid post connection and conveyed through the posts to the ground. There are no cumulative vibrations in this continuous system as there are in ordinary mill buildings where the posts are all cut and pintle

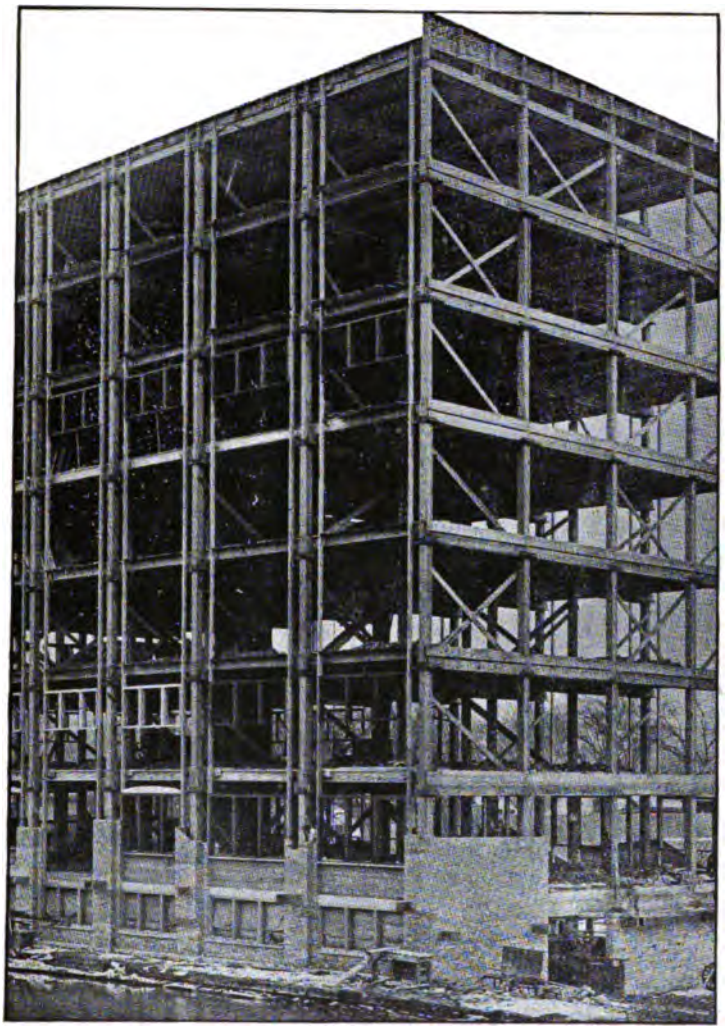


FIGURE 7.

FIGURE 8.

connected from story to story; the girders themselves being usually jointed at the same point. This forms a hinged or movable connection so arranged that the vibrations of the central floor section or bay when they reach these connecting and movable points continue on to the next section and finally butt against a mass of brick work which if it cannot be knocked over will stop the vibrations.

This is an unneccessarily expensive way of overcoming this trouble. For more than ten years I have made plans for buildings in which these vibrations have been taken care of in a much simpler and less expensive way. While by the use of this continuous skeleton system we add stability and light and secure all the other essentials for a good cotton mill building, we also reduce rather than increase the usual cost of such buildings.

The engineering facts that put a substantial bottom under all this method of construction, I have secured, at no inconsiderable expense, from published and unpublished records of strength and fire tests that I have made and others that were made under the supervision of the late Professor J. B. JOHNSON. They show the increased percentages in weight-bearing values of properly built up beams and posts. I have one of those certificates in my pocket and will read it; it is worth listening to.

This is a record of the test of a built up post 14″x14″ starting with a 4″x4″ solid core, and completed by spiking around it a continuous series of 2-inch plankings. "It was built of short leaf yellow pine, of 2-inch plank dressed down to 1¾ inch. The plank had seasoned in the yard about a year. These tests indicate a strength equal to that of solid columns, having a like degree of moisture. This stock was graded as No. 1 common." This that I have read is from this test certificate signed by Professor J. B. JOHNSON. The actual weight sustained by this post in the testing machine before anything gave way was 800,000 pounds—400 tons. At that point a plank on one side which had a large knot in it cracked, and the post bent slightly in that direction. The testing machine stopped and then began to run this record down as the post straightened up. This

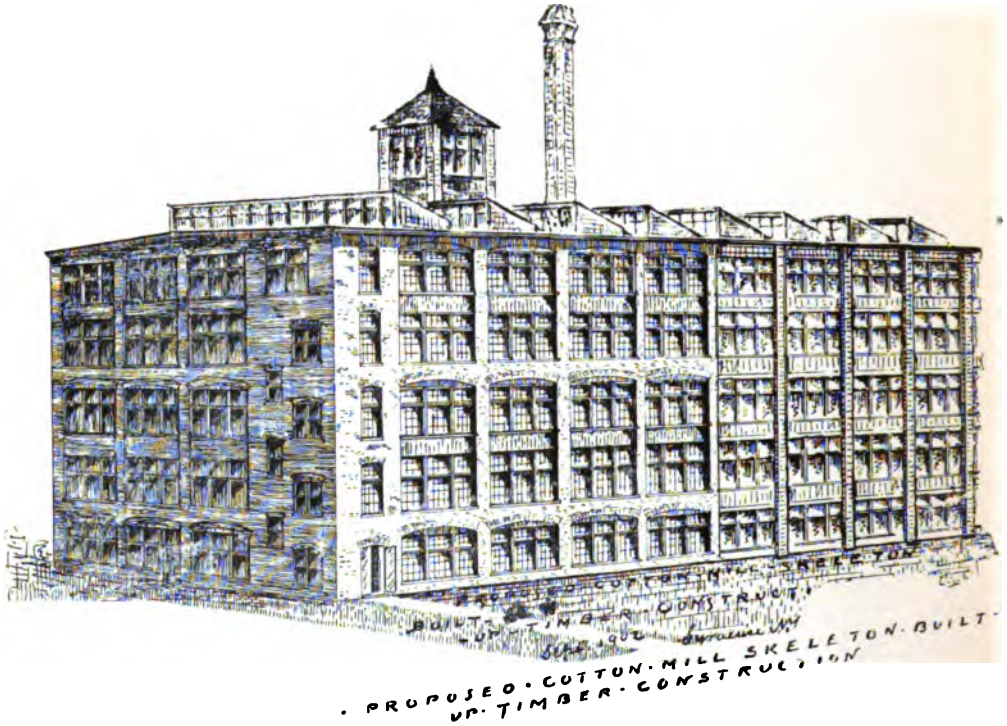

PROPOSED · COTTON · MILL SKELETON · BUILT
UP · TIMBER · CONSTRUCTION

FIGURE 9.

damaged post finally straightened up under a load of 762,000 pounds, showing an equivalent in breaking strength of nearly (4) four tons per square inch of its cross section.

These and details of like character and others showing the extra values of continuous construction, as recorded in the recent writings of F. E. KIDDER, Consulting Engineer, I have on file in my office in Syracuse. They can be had there or as shown in details and plans of this class of construction by those who are interested in this type of construction (either architects or owners) who wish to take advantage of and use the salvage values and extra stability and light they provide; and who believe that it pays to pay reasonably well for special skill and intelligence in these directions; or, as it is sometimes said, are willing and prefer to "pay for brains as well as for brawn."

The PRESIDENT. Is there any discussion on this paper.

Mr. SANFORD E. LORING. I shall be very glad to answer any questions that can be asked.

Mr. THOMAS H. SMITH. Tell us about the insurance of these buildings, Mr. LORING.

Mr. SANFORD E. LORING. It would be hardly fair to state publicly any details with regard to rates of insurance, although I am very proud of the facts. I will simply state that most of, if not all of these buildings, have been and are now insured in the New England Mutuals. I need not tell *you*, that the New England Mutuals are rather critical, some of them especially so, in selecting the buildings which they are willing to insure at low rates. Some of the mills that I have planned, I have been told, have the lowest rates allowed them that are given in any of their class of buildings, one cannot ask for or expect more than that.

Mr. ARNOLD B. SANFORD. I would like to inquire of the gentleman if he has ever built a cotton mill, say four stories, and stocked it with heavy cotton machinery?

Mr. SANFORD E. LORING. No, not a cotton mill, but I have built a mill, the interior of which I have shown you here, four stories high, in which the upper story was used for weaving wire cloth. I know that the vibrations connected with that class of machinery are quite as violent and I think much more so, than any machinery that is used in a cotton mill. I know that in the top of that building this wire weaving work was carried on for more than two years without disturbing the people that were occupying the lower stories. It was regarded at the time it was put up as an impractical thing to do, but the building part was never in any sense a failure. And so with my experience in these tower buildings and others, I would not hesitate to build a mill four, six or more stories high, if there was any advantage in it, and put any of your machinery in the upper stories, feeling sure that it could be worked as successfully and thoroughly there.

In further consideration of this matter of relative and possible stability I may add this. In the course of this hasty inspection of some of the southern cotton mills — and it was the first time that I ever went through a cotton mill thoroughly in my life — I found two cases where they had tripod straps that connected the posts of the upper story with the roof girders. I asked the mechanical engineer why they were put there, and he replied "to hold the roof down from shaking, and also to prevent its being blown off again by high winds." Since every floor in this skeleton construction as well as the roof are tied to continuous columns from top to bottom without a break and at the bottom the whole is anchored into the concrete foundations, I have never felt at all alarmed about the blowing off of either story or roof, nor have I since my tornado experience with this 30 x 30 x 110 feet tower felt that any serious results could come from any vibrations in any part of this type of building.

In the second story of a machine shop which I built some

years ago in Oswego, where they had planned to install light machinery, they put in heavy planers. A planer which cuts a shaving as thick as this pencil every time it hooks in, produces a violent reaction that would shake almost any floor. I have put my hand on the post directly back of that planer when it was working, and all I could feel was a little throb not stronger than my own pulse.

Mr. ARNOLD B. SANFORD. Mr. President, how does Mr. LORING tie his cross piece when he comes up to the post?

Mr. SANFORD E. LORING. The cross piece that is cut out by the post, butts against it and if it is not as wide as the post it is furred out on each side and what I call cantilevered members pass over the girder, each side of the post uniting the beam on one side with the beam on the opposite side. All the other beams, where beams are used, are made continuous, part of the members being cantilevered members and the other members extending from girder to girder.

Mr. JOHN E. PREST. The question that I was going to ask was answered in the last question — if Mr. LORING had made any test of putting looms in on the upper floor. That was substantially answered. I mean where you drive a number of looms on the upper floor, for instance.

Mr. SANFORD E. LORING. I think there were 20 of these wire weaving looms in the building 60 feet wide that was shown by this enlarged photograph.

The PRESIDENT. It might be interesting, Mr. LORING, if you would state roughly the relative cost of this construction as against the usual mill construction and also the time occupied in constructing a building under these plans.

Mr. SANFORD E. LORING. The cost of these buildings during the last 13 years — and most of the buildings that I have

planned have been erected by the day so that very close track could be and was kept of the cost — has ranged from 10 to 25 per cent. less than ordinary brick and joist constructions. A few days ago I picked up a fragment of a paper which was read before your Association some years ago by Mr. EDWARD ATKINSON, in which he said something like this: "No one would pretend but that there were fire proof constructions which were superior to mill construction in fire resisting value, but that mill construction was developed on the lines of economy and that the cost was 75 cents per square foot of floor area. I assume that this is a general average of the cost of such buildings. Buildings of this type which are equally valuable for cotton mill purposes have been built at a cost little above 55 cents per square foot of floor and roof area.

Mr. ARNOLD B. SANFORD. Have you any question in your mind that a cotton mill could be built 100 feet wide and 600 feet long, stocked with any machinery, and have no vibrations, and be insured just as cheaply as a brick wall compared to your construction?

Mr. SANFORD E. LORING. I would not say no vibration, but less vibration — much less vibration — than in the present type of mills, and since these buildings are insured by the Mutuals, in which they manufacture furniture, I assume that they would not hesitate to insure a similar building if it was used as a cotton mill. I know that the buildings are being put to uses that require very much more stability than any building used in the manufacture of cotton goods, and I have never heard any complaints. They seem to stand up under this extraordinary service and if the owners are inclined to complain they have not advised me.

Mr. ARNOLD B. SANFORD. What would you recommend for the outside planking of the mill?

Mr. SANFORD E. LORING. I recommend in all cases the use

of thin plankings; that is, two-inch and one-inch matched plankings, and to have them kiln dried. The panellings in a small mill were made of two-inch plank, a layer of felt, and a course of a one inch planking laid diagonally. Parts of that mill were faced on the outside with four-inch brick and a portion with asbestos and metal sheathing. I recently secured figures for the lumber for a building which the National Casket Company are now putting up in Nashville, Tenn., and found that the lumber trade would deliver kiln dried yellow pine two inches in thickness, varying from 2 x 6s to 2 x 12s and from 16 to 24 feet in length at an average price of nearly six dollars less than they would furnish green timbers. I accent *green* timbers, because the records of the United States Department of Forestry during the administration of Prof. FERNOW gleaned from the tests made by the Watertown Arsenal and the laboratory of Washington University at St. Louis by Prof. JOHNSON show a number of conclusions that were definitely and positively settled, and one of these was that dry timber was twice as strong as green. The practical strength tests of this class of built up work (as Prof. JOHNSON said built up as he never saw posts built up before) that were tested in this labratory, showed that built up posts starting with a central solid core and finished with continuous rings, showed every time much greater strength than the average solid stick, even surpassing the records of dry sticks which Prof. JOHNSON had been able to secure and had tested in his laboratory.

Mr. THOMAS H. SMITH. Would they not season in the cotton mill all right without being dried? The rooms are warm.

Mr. SANFORD E. LORING. Oh, yes, they would season all right and crack liberally in seasoning. Sometimes the cracks are fine and distributed generally through the mass, and sometimes they are all merged together in cracks into which you can put your finger. But this is only the natural result that follows these simple facts in regard to the seasoning of timbers; first,

a thin outside skin seasons and it shrinks and then others follow in order from outside in, and as they all shrink over an unshrunken core, they all crack. Your solid stick when it is seasoned consists of a series of cracked skins. You cannot get a seasoned timber and have it in any other conditon. When you bore a hole in the center and begin to season it from the inside also, you simply reverse the order of shrinkage and have the cracks running in from another direction; when this timber is seasoned it is also a series of cracked skins. It is a better plan to take your green stick in the beginning and slab it into two inch planks. It dries much more rapidly and in this relatively rapid drying there are less of these fine seasoning cracks than in the drying of timbers 6 to 16 inches square.

You get the dry planking results quicker, and when they are re-assembled, using this intelligence in putting together the pieces, you get quickly a dry stick that is dry from center to circumference, and, as the records show, stronger and better than even dry timbers, and twice as strong as green timbers. These built-up frames are erected at — I will say to keep well within the limits — two-thirds of the cost per thousand at which solid timbers can be handled. That I know from experience to be a fact. When an engineer recently asked me why that was so, I told him I could not tell all the whys and wherefores, but one thing I knew, that in buildings of this kind we hadn't any "loafiing labor" around. He laughed, for he saw in an instant that I referred to the reserve gang of extra help that must be on hand when you handle heavy timbers. After one or more timbers are laid in place there is little if anything for this extra help to do until it is time to erect another stick. In this class of built-up work there is something for everybody to be busy about all the while; the pieces go into place, piece by piece, in consecutive order, post, girder, beam and floor, and they are going up and being spiked in position constantly; the process is continuous; there is little or no interruption and no excuse for any man standing around with his hands in his pockets waiting for a job.

Mr. ARTHUR H. GULLIVER. I would like to ask the question whether you would recommend that construction in putting timber into a mill where you are going to change the lay-out of shafting or supporting heavy weights? Would you put in that same construction of spiked two-inch kiln-dried planks to take the place of hard pine timber?

Mr. SANFORD E. LORING. I would, and have done it.

Mr. ARTHUR H. GULLIVER. How would you secure that to your regular full sized beams that go across the building?

Mr. SANFORD E. LORING. I cannot answer that as I could if you will show me just the relative conditions that you have in mind.

Mr. ARTHUR H. GULLIVER. Well, suppose we had a 12 inch by 12 inch hard pine timber across the room, and we had to put up a 12 inch by 12 inch construction that would support the iron work that is going up in the upper part of the room; how would you secure that to 12 inch by 12 inch timber that was already installed in the cross beams?

Mr. SANFORD E. LORING. I do not even now see your conditions. The beam that you refer to is a floor beam?

Mr. ARTHUR H. GULLIVER. It is a floor beam that runs from one side to the other across the mill.

Mr. SANFORD E. LORING. Now what is your problem?

Mr. ARTHUR H. GULLIVER. I want to secure a construction between those timbers that would hold up a heavy weight — a dynamo, for instance, that would drive shafting in the mill.

Mr. SANFORD E. LORING. Is that weight to be supported on the floor between that timber and another timber?

Mr. ARTHUR H. GULLIVER. Between two timbers running

across the width of the mill, and I want to know whether you would put in a built-up stick to hold that weight up there in its place?

Mr. SANFORD E. LORING. Certainly. I see. Yes.

Mr. ARTHUR H. GULLIVER. Do you frame that built-up stick into the two timbers across?

Mr. SANFORD E. LORING. No, I should not frame it in; I should hang it on with stirrups, and hang it with stirrups that could and should be buried in the wood so that they would not be distorted or damaged by heat if you had a fire in that neighborhood. I use concealed stirrups whenever stirrups are required, that can be buried and concealed in the built-up sticks: exceedingly simple things and very efficient.

Mr. ARTHUR H. GULLIVER. That is, you would put that in the old floor timber?

Mr. SANFORD E. LORING. I should hook them on top of the old floor timbers and let the new floor framing rest on the feet of these stirups and the bottom casing piece that I would put under the built-up timber would bury them out of sight and beyond immediate danger from heat.

Mr. JOHN E. PREST. Mr. GULLIVER started a question that I wished to ask of Mr. LORING. Supposing he wanted to put some floor timbers, say 50 feet, across the room, about 12 x 14, and could not very well get timbers long enough or it was difficult to get them, would he advise building those timbers of two inch plank and spiking them together or bolting them together in such a form as that. Would it be stronger than the solid timber if you purchased it?

Mr. SANFORD E. LORING. Yes, sir, that has been done. In the Ames Building at Oswego, N. Y., the erecting shop is 50 feet

wide, spanned by a single truss constructed of two-inch plank spiked together. We also took the precaution to box in with heavy wood all the iron work in these trusses to prevent its rapid expansion by heat, in case of fire, and the rapid collapse that follows when iron work is exposed to sudden or extreme heat.

Mr. JOHN E. PREST. You would advise building timbers up in preference to having a solid timber?

Mr. SANFORD E. LORING. Always.

Mr. JOHN E. PREST. Is it stronger?

Mr. SANFORD E. LORING. Yes, if, as the Yankees say, a little gumption is used, you will always secure better results.

Mr. JOHN E. PREST. I had a short time ago an experience in that line. We needed some timbers 50 feet long but could not get them. We finally got some 30 odd feet long, 12 x 14, and spliced them and put them in and they are very heavy things to handle when you get them up on the third floor.

Mr. SANFORD E. LORING. Yes, it is much easier to put or "stick" them up in sections two inches thick.

Mr. JOHN E. PREST. It is quite difficult to get them (heavy timbers) up. The balance of the timbers we built up of three-inch Georgia pine 3" x 15", I think it was, and bolted them together, using bolts and dowels. We had quite a number of them reaching the 50-foot span. We thought we would run the chances since we could not get solid timber to build them up.

Mr. SANFORD E. LORING. I think you were taking no chances. The only thing I object to is your use of bolts, because bolt holes cut out many strands of wood fibre which I would rather have left intact. It is the fibre of the wood that gives us the strength we need, and it is not the bolt that does this business for us. I have eliminated the use of bolts almost

entirely from all built-up constructions. You can do all that is needed with wire nails or spikes, with points that separate and do not cut the fibre. I have little use for bolts.

Mr. ARTHUR H. GULLIVER. I would like to ask whether you use a wire nail for that spike.

Mr. SANFORD E. LORING. Yes, sir, we use wire nails and coated wire nails if we can get them.

Mr. CHARLES H. MERRIAM, JR. Forty penny or sixty penny?

Mr. SANFORD E. LORING. All sizes from ten to seventy.

Mr. JOHN E. PREST. You spike in preference to bolting?

Mr. SANFORD E. LORING. Yes, sir, always, for the reasons that I gave you. When you bore a hole for a bolt you destroy certain lines of continuous fibre, and it is the wood fibre and not your bolt that gives the needed strength or "does the business." The value of your wood work depends upon the tensile strength of this fibre and its power to resist compression. That is all there is to save it. Your spike or bolt merely prevents it from buckling or bending sideways and serves the same purpose that spiked wood bridgings do in ordinary joist constructions, and has no other use.

Mr. JOHN E. PREST. I have had occasion to put up two or three small bridges, 40 or 50 foot span. We used two-inch plank and round spikes, and spiked them together. We found we got a very stiff timber and it answered the purpose very well.

Mr. JOHN W. FRIES. Mr. Loring speaks of building up posts in this manner. Are we to understand that he uses the same construction in his girders, or does he use wide planks?

Mr. SANFORD E. LORING. For beams or girders I use deep planks and the bottom casing pieces, and sometimes top casings that cover the joints, below and above.

Mr. JOHN W. FRIES. The four-inch "solid" core is only for posts?

Mr. SANFORD E. LORING. That is all. In beams we aim to secure and use the greatest tension value of each member. We found in testing these built-up sticks that whenever beams failed it was on their tension side.

Mr. JOHN E. PREST. Would you advise using a two-inch in preference to three-inch plank?

Mr. SANFORD E. LORING. Yes, sir, because it is easier to handle, much more readily seasoned and is cheaper in the market. You will find that there is a difference of two to four dollars per thousand in yellow pine between two-inch material and three-inch. I would rather have the two-inch; you can now get it quickly seasoned. Some members of the lumber trade realize that it pays to season such yellow pine plankings in order to save transportation, and they are delivering such stock in Nashville and have delivered, in competition with hemlock for buildings that I designed and were built in Western New York, seasoned yellow pine stock. They have been building during the last few years very extensive dry kilns in the West and South and dry their material to save transportation: They really kill two birds with this one stone: that is, they not only save freight but increase the engineering value of this material. I do not know how many know that all this is true, and that increased strength is secured by drying, but it is true just the same, and those who know it can take advantage of these facts.

The PRESIDENT. The next paper is on Bleaching and Finishing of Textile Fabrics, by Mr. A. C. FREEMAN, New York City.

*BLEACHING AND FINISHING OF TEXTILE FABRICS.

A. C. FREEMAN, New York City.

In the sizings of yarns for piece goods, the question of whether this or that material entering into its composition will be of advantage or otherwise in the bleaching and finishing, is rarely, if ever, considered by the manufacturer.

As long as he can get his warps through the weave room and into cloth with the minimum amount of trouble and expense his interests end there.

The bleaching, finishing and putting the goods into proper condition for the market are duties which does not concern him and whatever difficulties arise later the finisher is expected to solve for his own salvation.

Of late, bleachers have experienced much trouble in getting out *pure goods*. In fact complaints in this direction appear to be very general, even the dyers of piece goods in some instances are experiencing their share of the trouble, in being unable to get cotton piece goods dyed evenly.

A close study has developed one cause, which, while it may not be the only one, is in itself certain to produce a serious defect in any piece of cotton goods, viz: the use of paraffine and similar substances in connection with the sizing of warps.

Years ago paraffine was brought to the notice of manufactur-

---

* For other papers on the subject of the Bleaching and Finishing of Textile Fabrics, reference is made to the Transactions of the Association in papers by EDWARD ATKINSON, Vol. 27, page 38; JAMES A. WALSH, Vol. 63, page 236; CHARLES H. FISH, Vol. 65, page 258; DANIEL MOORE BATES, Vol. 66, page 226; HENRY G. KITTREDGE, Vol. 71, page 274.

ers and was adopted by many mills, as its use improved the weaving qualities of warps. Almost immediately a huge wave of misfortune began to roll in. First came mildewed grey goods, for the simple reason that where paraffine is used in warp size, it simply remains therein in the form of an emulsion, so that when the warp is saturated with the sizing material the moisture penetrates the same, but the paraffine remains on the outside. In drying the moisture cannot get out, although the warp appears dry, as paraffine hardens at quite a high temperature, but in a short time the absorbed moisture generates mildew.

Next came the bleachers inability to get *pure goods*, as paraffine is a peculiar article, and will not dissolve in any of the chemicals that are used in the process of bleaching.

Paraffine is insoluable in water, but soluble to some extent in boiling alcohol, in ether, oil of turpentine, oil of olives, benzol, chloroform and sulphide of carbon. Acids, alkalies and chlorine not acting upon it at ordinary temperatures, consequently it cannot be removed entirely from cotton piece goods by processes that are practical and safe, and wherever the cotton fibre is coated with it, the bleaching chemicals are resisted, so resulting in impure goods.

The dyer found his pieces uneven from the same cause. In boiling off, he simply spread the paraffine on to the filling, and wherever it remained, had spots of a lighter shade after the dyeing process; as his dye liquor could not penetrate through a material which resisted it.

These results caused paraffine to be discarded in a very decided manner and it is to be regretted that it has appeared again, although its use is at the present time restricted to some of the newer mills, the older ones not having forgotten past experiences in this direction.

Mr. JOHN W. FRIES. My experience as a finisher is so limited as to hardly qualify me to discuss this paper, but I would have asked Mr. FREEMAN, had he been here, as a finisher, whether he found the same trouble arising from some of the secret sizing compounds that are offered. In my limited experience as a finisher I have found just that trouble. I had undertaken to finish the product of 100 looms for a certain mill, and trouble arose so that I was unable to finish it at all, and I finally located the trouble in some secret sizing compound. Whether it contained paraffine or not I cannot say; who made the compound I cannot say, but I do know that it was unfit to go on the warps to be finished, and I wanted to ask Mr. FREEMAN whether that was his experience.

The PRESIDENT. We will now proceed with the reading of the last paper for the evening, The Card System in Mill Supply Accounts, by FRANK P. VOGL, Claremont, N. H.

*THE CARD SYSTEM IN MILL SUPPLY ACCOUNTS.

FRANK P. VOGL, Claremont, N. H.

The method explained is an adaptation of a book, called "Purchase Record," combined with a card index system that has proven its value with time and has the merit of being simple in method and may prove of value to the smaller mills where the Agent is not many removes from the book-keeping department.

Illustration No. 1 shows a requisition blank that is bound in block form and distributed to overseers and heads of departments and all orders for supplies are made on these blanks, and also goods ordered in office are made on the same form. As soon as an order is given, the name of firm is put on the blank and the item is then entered in the Purchase Record, a sample leaf of which is shown in Illustration No. 2. This Purchase Record is a double leaved book and the order is placed on the left hand page and when goods arrive the charges of invoice, freight, etc., are entered on the right hand page. Each six months the purchases are added up on the Purchase Record and the additions are put upon cards with the name of the supply and Illustrations Nos. 3 and 4 show two items, which I have selected as showing how minute the record may be made. These cards are indexed and kept in a wooden case, preferably on the desk of the Agent, so that at any time it is easy to turn

* For other papers on the subject of Mill Accounts, reference is made to the Transactions of the Association in papers by A. O. KITTREDGE, Vol. 70, page 155.

Return to Office when Goods Come.

June 15,1902

Please order for Card Room

Ordered from Brown, Jones & Smith

100 ft 2 inch leather belting

received O.K. 6/21 E.C.B.

FIGURE 1. — REQUISITION BLANK.

·66

ARTICLE Leather Belting

DATE OR ORDER NO.		ORDERED FROM	QUANTITY AND KIND	PRICE AND TERMS	WHEN DUE	REMARKS
June	15	Brown, Jones & Smith	100 ft 2"	60 & 10 off		

ARTICLE

DATE OR INVOICE NO.		RECEIVED FROM	QUANTITY AND KIND	PRICE AND TERMS	FREIGHT		TOTAL COST		REMARKS
					Rate	Paid			
June	20	Boston	100 ft 2"	34¢ 60,10		14	12	38	

FIGURE 2.—PURCHASE RECORD.

Valves

SIX MONTHS ENDING	QUANTITY PURCHASED IN SIX MONTHS											COST DELIVERED		REMARKS
	1/4	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	all sizes			
May 31. 1896		12	12	6		6		4				90	96	
Nov 30. "						20	2	2				75	77	16 73
May 31. 1897							1		1			11	85	
Nov 30. "		1		5	1		1			1	20 Rubber	32	18	49 95
May 31. 1898				1		1	1					6	34	
Nov 30 "		3	5	5	2				1			20	35	26 69
May 31 1899		12	16	6								29	45	
Nov 30 "			3			1	6		1		1-12"	97	65	127 40
May 31. 1900				1	4	1	2	1		1	8 Condenser	99	99	
Nov 30. "	12	4	12			5						67	69	165 68
May 31. 1901		16	4	3		1					12 Vacuum 1-12 wedge	142	49	
Nov 30. "		19	19	19	8	8	3	1				117	80	160 29
May 31. 1902			6	20		16	2			5/32	32 Rubber 105 discs	133	14	

FIGURE 3.—CATALOGUE CARD.

Belting

SIX MONTHS ENDING	QUANTITY PURCHASED IN SIX MONTHS										COST DELIVERED		REMARKS
	1	1¼	1½	1¾	2	2½	3	Double 3	4 ply	all sizes			
May 31 1896		250	150	101	100	154		202	104/6	450/15/16	206	46	
Nov 30 "			109		214	256	22			6/8	98	40	304 88
May 31 1897	213	100					100		50/4	100/3/8 50/8	76	65	
Nov 30 "			204			250		204	105/6		170	78	249 42
May 31 1898			100			150		102	25/4 53/6	66/8	142	88	
Nov 30 "		113	100		106	100	100		50/4 111/6	Spanner 30"	160	86	303 14
May 31 1899				102	228	50	113	100	52/6		156	50	
Nov 30 "		104	50		112	378	111	100	12/5	65/7 62/14	456	59	613 09
May 31 1900		204	257		200	150	100	201	192/4 158/6	Spanner 9" dia	425	52	
Nov 30 "	200		30	109	110	259		317	54/4 10/5	41/10 97/96	33 15 311 83 712	28	1184 50 414 42 726 61
May 31 1901	100		154		110	267		208	179/4 112/6		341	62	
Nov 30 "			50		107	159	109	203	60/4 50/150	50/8"	203	02	544 64
May 31 1902			201½		201	100 lbs 209	206	105	118/4 64/4		299	13	

FIGURE 4. — CATALOGUE CARD.

to the proper card and note just the amount used for six months, being a convenient guide as to purchases for the future and also showing if an undue amount of any supply has been used. More frequent entries could be made on the cards, but, as most manufacturing concerns make up accounts each six months, it is convenient to make entries of supplies used during the same periods.

As such a system becomes older, it is valuable as showing the comparative cost of supplies during one period with another and often shows how a change in the material of supply may be a saving in the cost. The marked difference in the cards shown in Figures 3 and 4 is due to "hard times" and mills being run at half capacity. The book referred to is made by The Fred. Macey Co., of Grand Rapids, Michigan, who are also manufacturers of card index systems but any of the firms dealing in card indexes can supply the cards.

The PRESIDENT. This finishes the program for the evening, and we will adjourn until tomorrow morning at half-past nine.

FOURTH SESSION.

THURSDAY MORNING, OCTOBER 2, 1902.

The Association met at 9.30 A. M., President FISH in the chair.

The PRESIDENT. We will now proceed with the reading of the papers. The first paper on the programme is Tension on Roving Frames. Mr. WILLIAM E. WINCHESTER, of Philadelphia.

Mr. WILLIAM E. WINCHESTER. Mr. President, members and guests of the New England Cotton Manufacturers' Association: The paper that I have to deliver this morning is one that perhaps is better adapted to the Transactions of the Association than to delivery here. It is one that is intensely theoretical and intensely technical, and for that reason I have had considerable hesitancy in delivering it to you. It is in the first place a paper which relates to one small detail of the management of a cotton carding room. It is also a paper which in the second place would probably deal with a subject that comes more within the province of an overseer or a subordinate than within that of an

* For other papers on the subject of Roving Frames, reference is made to the Transactions of the Association in papers by SAMUEL WEBBER, Vol. 35, page 31; JAMES NASMITH, Vol. 61, page 213.

agent or a superintendent or a treasurer. But although the subject, is a small one, it is, I think, not too trivial or too unimportant to receive considerable attention by everybody. And even although it is within the province of the overseer, it is probably true that no people can impress upon the overseer the duty of studying such a subject better than the manufacturers here assembled. The subject I have is Tension of Roving Frames.

*TENSION ON ROVING FRAMES.

WILLIAM E. WINCHESTER, Member of Faculty of the Philadelphia Textile School.

"Evenness of Roving" has always been a subject of importance, and must always be a most potent factor in the production of good yarn and cloth. Much has been said and written upon the causes of uneven roving and yarn due to derangements of the machines and their parts, but to a thorough understanding of the working of the machines too little attention has been given except by thoughtful and ambitious overseers themselves. It is my intention to point out one of the most common causes of unevenness, and to attempt to clarify some matters relating to the rather imperfectly understood subject of tension on roving frames.

It may be said in a general way that tension means the amount of pull on the strand of cottton during its passage from the front roller to the bobbin. It is evident that the pulling of the roving from the front roller is due to the fact that the bobbin barrel is made to revolve at a speed greater than the speed of the flyer through which the strand of cotton passes on its way to the bobbin. The traverse of the bobbin rail and the decrease of the excess speed of the bobbin perform the winding. I shall endeavor to show (1) what relation should exist between the speed of the front roll and the speed of the bobbin, (2) how it is possible to determine whether this condition holds at any special time or not, and (3) in what manner the relation may be maintained throughout the building of the entire bobbin. The

* For other papers on the subject of Roving Frames, reference is made to the Transactions of the Association in papers by SAMUEL WEBBER, Vol. 35, page 31; JOSEPH NASMITH, Vol. 61, page 213.

surface speed of the front roll and the excess surface speed of the bobbin over the flyer should be equal. Such has been the well founded and almost universally accepted theory for many years. The reason justifying such a theory has not received much attention and consequently is so little understood that I have deemed it worth while here to explain it. In such a condition as above referred to there is wound upon the bobbin just as much roving as is delivered by the front roller; a greater speed of the bobbin would obviously produce a draft between the front roller and the bobbin, while a less speed would cause slackness, consequently preventing winding. Few machine builders have constructed their machines on any other principle. One maker has dared to depart slightly from universal practice by making the initial excess surface speed of the bobbin a little greater than the surface speed of the front roller. A slight draft at this point is not in itself excessively detrimental to the making of good roving, but the maintenance of a constant draft throughout the formation of the bobbin is impossible on the present type of roving frame. As a result of this variable draft the uniformity of the roving cannot be maintained; the variation will be slight but appreciable. If the surface speed of the front roller and the excess surface speed of the bobbin be equal, then if the parts which give this excess speed; namely, the driven cone drum and its connections, are stopped, the speed of the bobbin will be exactly equal to the speed of the flyer. It will be readily understood then that the speed of the bobbin is made up of two parts, *i. e.*, a speed equal to the speed of the flyer, and another speed which I have called the excess speed of the bobbin.

When the bobbin increases in diameter the excess speed of the bobbin must be decreased. Of course the actual speed of the bobbin is at the same time decreased, but it is only the decrease in the excess speed that affects the problem of winding, and it is only those parts of the machine governing the excess speed that have their own speed changed. The cone drums, or more properly the speed of the driven cone with its

connecting gearing controls the excess speed of the bobbin. Any decrease in the speed of the driven cone has a proportionate effect upon the excess speed of the bobbin. It is quite obvious then that as the diameter of the bobbin increases so must the excess speed of the bobbin decrease. For if at one time 225 inches of roving be delivered when the circumference of the bobbin is 5 inches, the bobbin must make 225 divided by 5 or 45 revolutions more than the flyer in order that winding may take place; whereas if the roller delivery remain constant, as is always the case while the bobbin is being formed, and the circumference of the bobbin increase to 10 inches, the excess speed must decrease to 22.5 revolutions. It will thus be seen that the following proportion shows the relation between the excess speed of the bobbin and its circumference: 45 : 22.5 : : 10 : 5, *i. e.* the excess speed of the bobbin varies inversely as its diameter. Since the driven cone drum controls the excess speed its speed must vary inversely as the diameter of the bobbin. In order to provide for such a variation of the speed of the driven cone merely by moving a belt along the cones it is necessary that they be constructed with their well known curved outline which approaches very nearly the mathematical curve called an hyperbola.

Remembering that the parts connected with the driven cone drum are the only parts whose speed is changed, and assuming that when those parts are thrown out of gear there is still an excess speed of the bobbin over the flyer, we may without much difficulty show that the draft produced cannot remain constant during the entire winding of the bobbin. The draft between the front roller and the bobbin is the ratio between the excess surface speed of the bobbin and the surface speed of the front roller, *i. e.* it is the first divided by the second.

Let i = the speed of the bobbin in excess of that of the flyer, when the driven cone drum and its connections are stopped.

d' = initial diameter of the bobbin.

d'' = diameter at some subsequent time.

a = speed given to bobbin by driven cone and connections during winding of first layer.

a' = speed given to bobbin by driven cone and connections when bobbin has reached diameter d''.

f = speed of front roller.

D = diameter of front roller.

Then during the winding of the first layer

$$\text{draft} = \frac{(i+a)d}{fD} \qquad (1)$$

and during the winding of the layer when the diameter of the bobbin is d'',

$$\text{draft} = \frac{(i+a')d''}{fD} \qquad (2)$$

If (1) equals (2), then the draft will of course be constant. Again if (1) equals (2), $(i+a)d$ must equal $(i+a')d''$, and the following proportion must be true:

$$(i+a') : (i+a) :: d : d''.$$

But as a matter of fact

$$a' : a :: d : d''$$

or, as previously shown, the speed of the driven cone, and consequently the speed given to the bobbin by the driven cone and its connections varies inversely as the diameter of the bobbin. Therefore since it is impossible for $\frac{i+a'}{i+a}$ to equal $\frac{a'}{a}$ unless $i=o$, the draft cannot be constant. The effect upon roving of a variable draft is too obvious to require discussion. Hence it is advisable to have machines so constructed that when the driven cone is stopped the speed of the bobbin and the flyer are the same.

It is in accordance with the foregoing condition that the gearing on roving frames has to be arranged and differential motions constructed. In order thoroughly to understand how to determine mathematically the actual speed of a bobbin at any time, to detect the existence of any undue tension or draft, one must have a good knowledge of what I have attempted to prove thus far, as well as familiarity with that highly interesting but generally imperfectly understood piece of mechanism known as the differential motion. I have thought it most pertinent here

to outline briefly three of the motions largely in use in this country, with the object of showing how they may be dealt with in the problem under discussion. The function of a differential motion on a roving frame is to receive speeds from two sources, to compound them and to transmit them as one, at the same time allowing one of them to be varied while the other remains constant. The variable speed is that one which comes to the

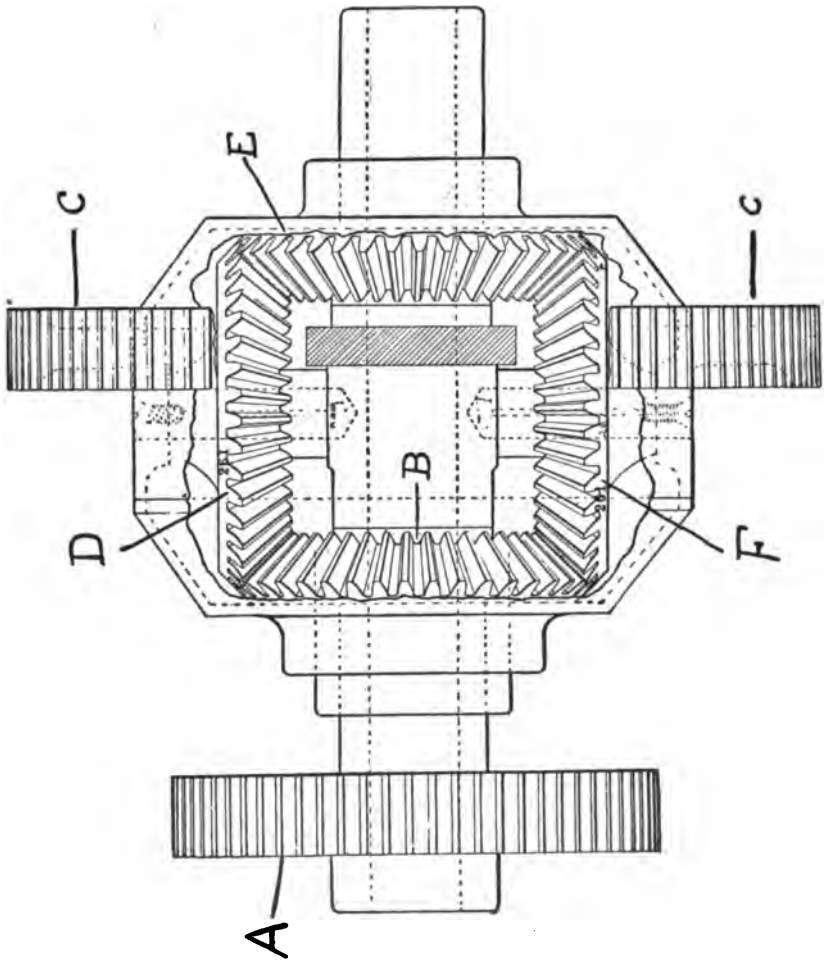


FIGURE 1.—HOLDSWORTH'S DIFFERENTIAL MOTION.

motion from the driven cone drum, and the constant one comes directly from the jack shaft. The oldest and best known type of differential is called Holdsworth's and is shown in Fig. 1. It consists essentially of four bevel gears and an encircling spur gear. One of the bevels E is fast upon the jack shaft. E meshes with F and D, which have their axes carried by the large encircling gear C, which runs loosely around the jack shaft. From A by a train of gears the bobbins receive their motion. C receives its speed through gearing connected with the driven cone drum. The power coming through C when transmitted gives the bobbins their excess speed, and the power coming directly from the jack shaft is sufficient to make the bobbins go as fast as the flyers if the bottom cone does not move. If the speed of A be obtained it is a simple matter to find the speed of the bobbins. It is also easy to determine the speed of E and of C. To find the speed of A knowing the speed of E and of C requires the use of a mathematical formula. One may be derived which is sufficiently general to apply to any style of differential motion constructed on the principle of epicyclic trains; *i. e.* trains of gears in which one is carried bodily around the periphery of another.

In all epicyclic trains there is what is called an arm; namely, that portion of the mechanism which carries one gear around another. In Holdsworth's motion the arm is C. The action of the arm always has some effect upon the speed of the last gear in the motion. If we substract the speed of the arm from the speed of the last gear or from the speed of the first or any other gear in the motion, we have the speed of the respective gear uninfluenced by the arm; *i. e.* as it would be if the train of gearing were of the ordinary type. In the ordinary type of gearing where gears mesh one with another without the intervention of a carrying arm, the value of the train is defined as the ratio between the speed of the last gear and the speed of the first gear, *e. g.* if the first gear of a train make one revolution and the last seven, the value of the train is $7 \div 1$ or 7.
Therefore let $t =$ value of the train in any differential motion.

l = speed of last gear.
f = speed of first gear.
a = speed of arm.

Then speed of last gear if influence of arm be removed $= l-a$ and speed of the first gear under the same condition $= f-a$.

Consequently $t = \frac{l-a}{f-a}$

or $ft-at = l-a$

whence $l = a-t(a-f)$. (3)

We can in the case of any differential motion obtain values for all the letters in the above formula except l and can thereupon solve for l. It is necessary in solving to note carefully whether the speeds are positive or negative; *i.e.*, whether the gears whose speeds the letters represent revolve in the same direction as, or in the opposite direction to the first gear, whose speed we may for convenience consider to be positive.

We shall now apply the formula to Holdsworth's motion. In this case B is the last gear, E is the first gear and C is the arm. The value of the train is found by considering that the gearing is of the ordinary sort, and then by finding the speed of the last gear while the first makes one revolution. B, D, E and F are all of the same size; hence for one revolution of E, B would make one revolution, but in the opposite direction. The value of the train t is therefore -1. We may then modify the general formula for this particular motion by substituting (-1) in the place of t, at the same time considering whether the first and last gears and arm go in the same direction. As a matter of fact, the arm C revolves in the opposite direction to E, as does B, consequently a is negative.

Substituting in (3),

$$l = -a-(-1)(-a-f)$$
$$= -a + (-a-f)$$
$$= -2a-f$$
$$\text{or } l = -(2a + f).$$

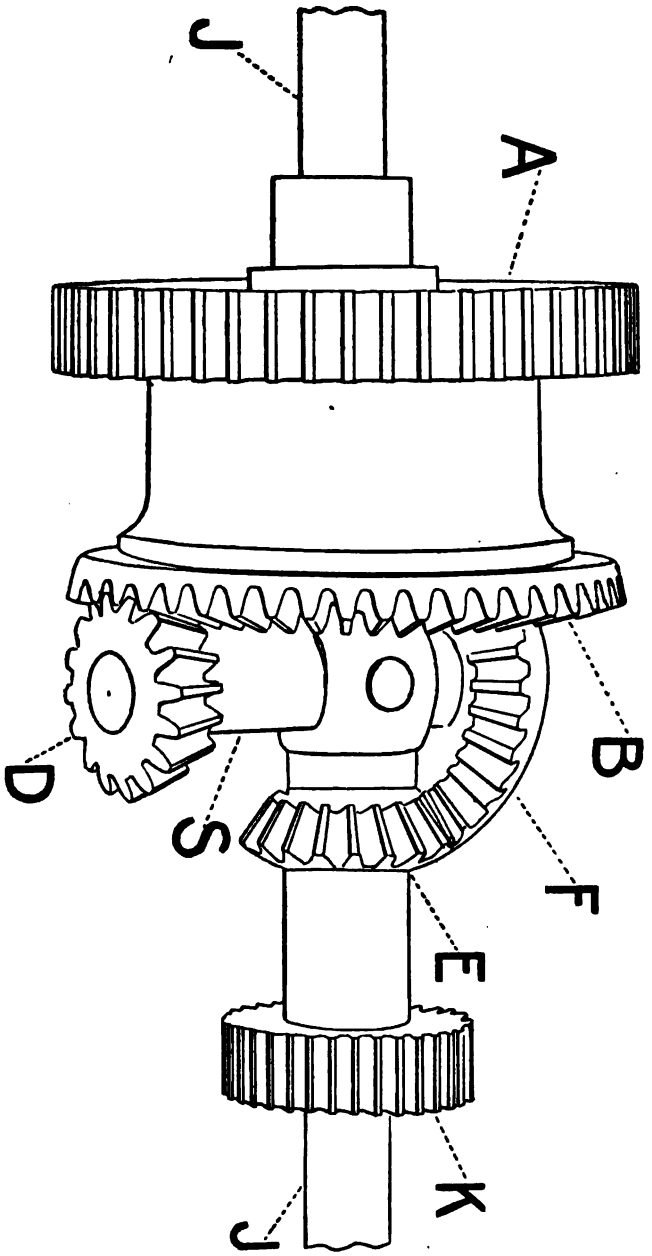


FIGURE 2.—TWEEDALE'S DIFFERENTIAL MOTION.

Therefore the speed of A equals twice the speed of C plus the speed of E. The minus sign simply indicates that the direction of revolution of the last gear is opposite that of the first.

The style of differential shown in Fig. 2 is called Tweedale's. The bobbin wheel A is compounded with the gear B which is the last gear of the motion. A and B can revolve loosely around the jack shaft J. Through a suitable bearing in the main shaft extends a short shaft, S, carrying the gears D and F, which are capable of being revolved on their own axes and of being carried around bodily by the revolution of the main shaft. They would then be made to roll around the gears B and E, D meshing with B, and F only with E. E is on a sleeve loose upon the jack shaft, and is compounded with the pinion K, which gets its motion from the driven cone.

Formula (3) applies with equal force to this motion. The jack shaft itself is the arm, E is the first gear, B is the last gear, and the value of the train is $\frac{E \times D}{F \times B}$, the letters of course indicating in this case the number of teeth in the gears. t is positive. All values for the letters in formula (3) are positive; consequently the substitution may be made very easily.

Daly's motion is shown in Figs. 3 and 4. It is an American invention and is the most recent of all. The arm is a large internal gear D fast upon the jack shaft. With it mesh the two spur carriers C and C'. These carriers are borne by studs fixed in extended portions of a sleeve loose about the jack shaft. This sleeve carries the bobbin wheel A, and surrounds an inner sleeve which carries the pinions E and F. E meshes with C and C', while F receives its motion from the driven cone. All parts revolve in the same direction, so that values in formula (3) are positive. The only point requiring discussion is the value of the train. The value of the train t is the speed of the sleeve carrying A while the first gear E makes one revolution. The case is slightly different from a straight train of gears, since even when the arm is stationary two influences are brought to bear upon the carriers C and C', one by E and the other by the

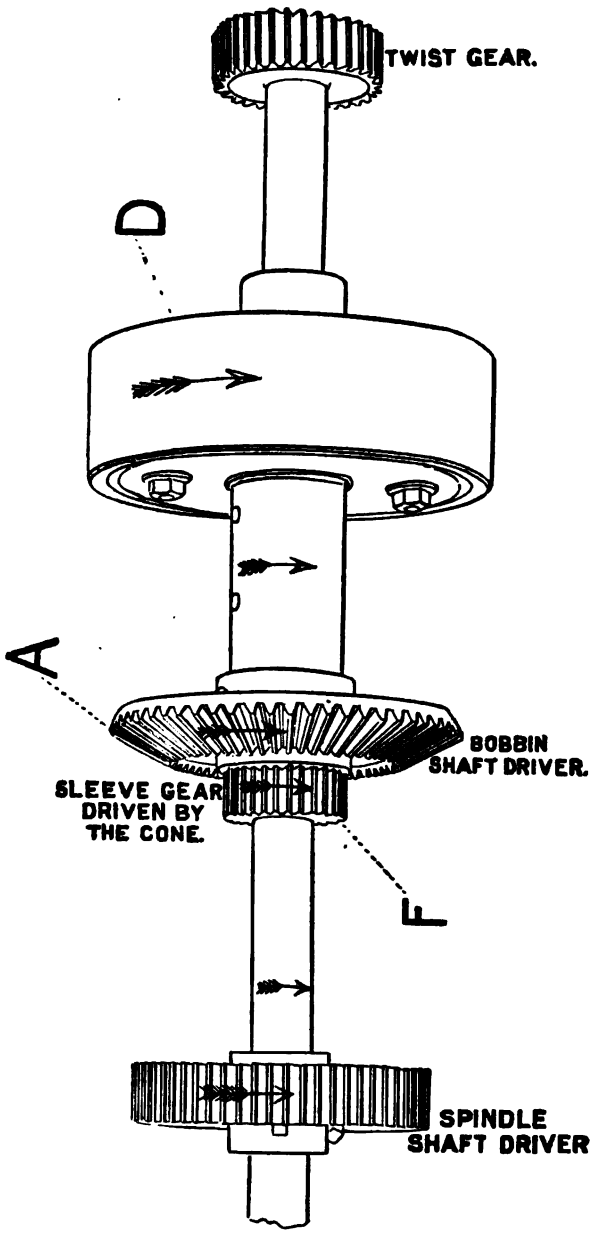


FIGURE 3.—DALY'S DIFFERENTIAL MOTION.

internal gear D. The proportionate amount of the whole power, that is exerted by E may be found by dividing the speed which it would give to the carriers if the gearing were of the ordinary type by the sum of this speed and the speed which the internal gear would give to the carriers under the same condition. That is, the value of the train

$$t = \frac{\frac{E}{C}}{\frac{E}{C}+\frac{D}{C}} = \frac{E}{E+D}$$

E and D representing the number of teeth in the gears. Knowing the values for a, the speed of the jack shaft; f the speed of E; and t the value just derived, substitution in the formula

$$l = a - t\,(a - f)$$

is not difficult.

From the bobbin driving gear of differential motions the speed of the bobbins may readily be calculated, and the absence or presence of draft detected. It is possible also to discover whether the proper "cone gear" is being used, and to find the correct one. This "cone gear" is one in the train from the driven cone to the differential motion, and may be changed in order to secure the correct initial bobbin speed. Too large a cone gear causes excessive tension; too small a one causes slackness. To obtain the size of the cone gear a calculation for the speed of the bobbin may be made, using x in the place of the unknown cone gear. By subtracting the speed of the flyer from this expression another will be obtained representing the excess speed of the bobbin. By making this last expression equal to the surface speed of the front roll divided by the circumference of the bobbin an equation will be formed which may be solved for x. The size thus found needs a slight correction due to the inevitable slipping of the cone belt. The percentage of slip may be determined by experiment. To facilitate the formation of a tight bobbin it is perhaps allowable to produce some tension by the use of a somewhat large cone gear. When

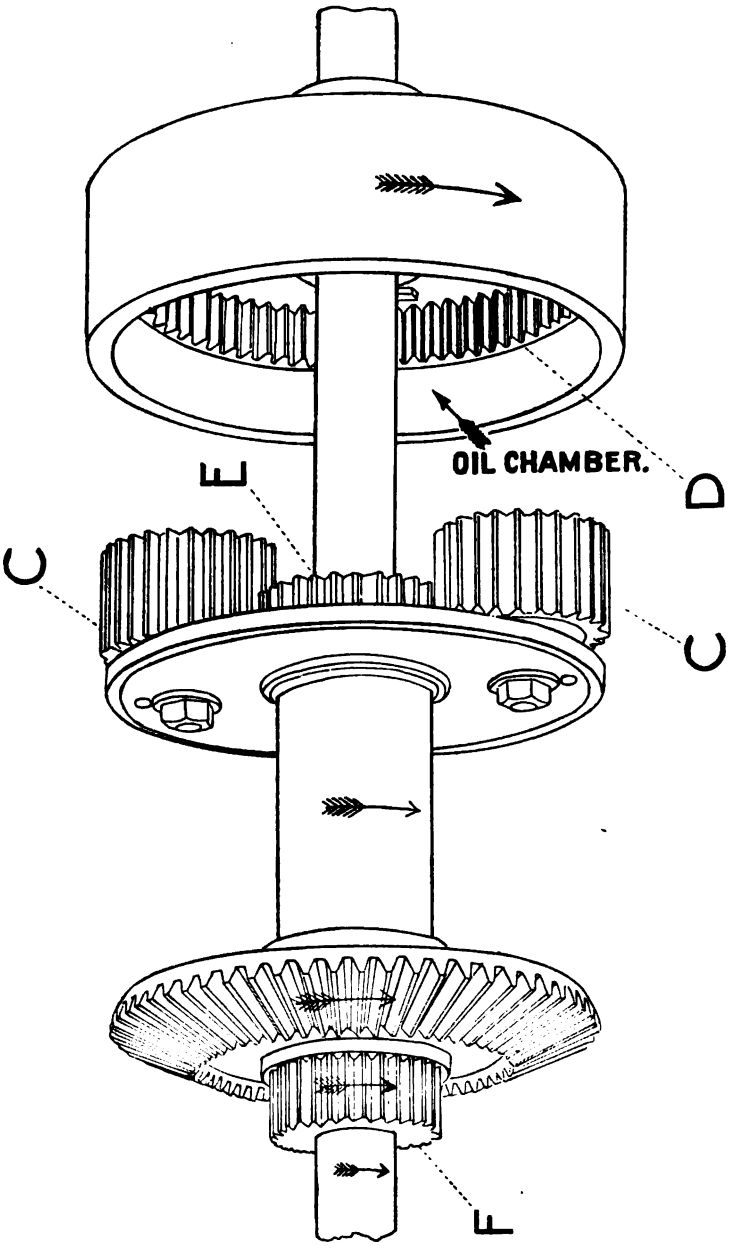


FIGURE 4.— DALY'S DIFFERENTIAL MOTION.

tension is produced from this source it has by no means the detrimental effect caused in the instance previously referred to. Very little deviation from a draft of zero, however, is allowable.

Assuming that the proper tension, so called, has been obtained for the winding of the first layer of roving, we still have the problem of maintaining a constant tension. Moreover the problem is undoubtedly the most difficult of all those connected with a roving frame. Varying conditions have so potent an influence that it does not always lend itself to simple mathemathical calculation. True, if all the conditions at one time be known, absolutely correct results for the time being may be figured and secured in no other way. The calculation needed is for the size of the gear called the "tension gear." The maintenance of constant tension depends upon a proper decrease in the excess speed of the bobbin, which is accomplished on all roving frames by moving the belt connecting the cone drums a fixed distance at the completion of the winding of each layer. If the distance be too great, the excess speed of the bobbin will decrease faster than the diameter of the bobbin increases, with the result that the roving will become slack. Too slow a movement of the belt prevents the excess speed from decreasing sufficiently to avoid increased tension and consequent stretch, possibly breakage of the roving. Much perplexity has been caused by the occurence of both of the above conditions due to a lack of thorough knowledge of the working of the parts.

The tension gear itself is one in the train between the builder motion and the rack that carries the cone belt. The distance traveled by the cone belt varies directly or inversely as the number of teeth in this gear, depending upon whether the American or the English style of builder motion is used. In either case the size of the gear required to make the belt move the desired distance may be obtained with tolerable ease; the distance that the belt should move, not so easily. Probably the simplest method is to find the number of layers that can be put upon a bobbin by finding the thickness of the cotton and the space occupied by each layer. The entire traverse of the belt

divided by the number of layers gives the distance moved after each layer. The difficult thing is to determine accurately the diameter of the roving, or more practically the thickness of a single layer. Attempts have been made to make rules for the number of layers that may be contained in an inch in terms of the size of the roving. While by no means absolutely correct, these rules give fairly good results. Temperature, humidity and twist influence the diameter of the roving and consequently that of the bobbin. Actual experiments must be made under different conditions, for no relation of diameter to number is general enough for universal practice. Continual watchfulness and study of conditions are ever necessary. Temperature and humidity can be controlled nowadays with considerable accuracy. When such is the case one observation will bring good results for a considerable length of time. Some variations are inevitable, but eternal vigilence can assist greatly in maintaining that relation which theory and practice have shown to be the best.

The PRESIDENT. Gentlemen, this very excellent paper is now open to discussion.

Mr. JOHN E. PREST. Mr. President, I notice on page 274 it says, "The oldest and best known type of differential is called Holdsworth's." The word "best" seems to be the important thing right there. We have other differential motions that seem to be improvements on the old things we had years ago. That old Holdsworth we have been using thirty or forty years. Now I would like to know what the improvements are, the advantages of the other motions; whether there is any saving in power in the new types. Sometimes changes are not always improvements. Is there any difference in power between the two motions represented here?

Mr. WILLIAM E. WINCHESTER. I did not intend in the paper to favor any special motion. I simply wanted to show the points of each one, to show how each one worked. Of course the makers themselves claim advantages for each one, but I did not care here to tell what my views were, whether I thought one was any better than the other or not. Most of them are good.

Mr. JOHN E. PREST. What struck me quite forcibly was, "The best known type".

Mr. WILLIAM E. WINCHESTER. Well, some will not agree, I am sure; some do not favor that type. A great many do favor that motion; it is a good one, undoubtedly.

Mr. THOMAS H. SMITH. Would Mr. WINCHESTER give us some practical rule by which the tension can be regulated which is within the comprehension of an ordinary carder? This is altogether too theoretical for the man in the mill. Is there some rule of thumb that we can take home with us that will do some good when we get there?

Mr. WILLIAM E. WINCHESTER. I do no recall any rule that can be gotten right down into the simplest practical language. I felt it necessary to go into a little mathematical work in order thoroughly to prove the problem. It is such a nice problem that it requires some rule of that sort to work it out. You can get at it in a more practical way; that is, you may see whether the actual operation is right or not, and if not, change the gear. But I think an understanding of these points is necessary, and if they are studied carefully, I think they will not be particularly difficult. There is a formula given there, and a substitution in that formula will give fairly good results. There are also rules for the relation between the number of strands that ought to lie side by side in an inch, and the size of the roving. Those rules are very useful. That is, the number of coils that ought to lie side by side in an inch is given in relation to the size of the roving; that is, it is either 9, 10 or 11 times the

square root of the hank roving which you are making; then, determining the number of strands which lie side by side in an inch, and determining the distance which the cone belt ought to move along the cones, you may carry out the calculation for the tension gear in the same way as the calculation for any other gear that would be carried out — the draft gear, or the twist gear, or any other — working through the train from one end to the other, considering the speed of the first gear as one and seeing what the speed of the last gear is, omitting the unknown gear or taking that as the unknown quantity and solving the equation for the unknown quantity. I am not prepared here in a few words to give any practical rule that could be used by the carders themselves, but in a little while I might explain one.

Mr. THOMAS H. SMITH. Of course that is too complicated for an ordinary carder. Suppose your frame is running too slack and you tighten the tension just so as to make it right, can there any harm come to the roving then? Can he get any nearer than that?

Mr. WILLIAM E. WINCHESTER. Well, no, I do not think he can, actually.

Mr. THOMAS H. SMITH. That is all I want.

Mr. WILLIAM E. WINCHESTER. But you can understand this was mainly to explain the theory upon which the thing was constructed, I did not aim to give rules about it particularly, because of course you cannot split a tooth on a gear, and as near as you can get is to put on a gear differing by one tooth if it is running imperfectly; but I wanted mainly to explain the theory on which the thing is constructed, because I thought it might be of interest to some who would later study it up. It is not an attempt to give the men practical rules.

The PRESIDENT. We will now take up the next paper, The Underfeed Stoker, by Mr. GEORGE C. TEWKSBURY of Boston.

*THE UNDER-FEED STOKER.

GEORGE C. TEWKSBURY, Boston, Mass.

It is not the intention in this paper to attempt to give a technical description of the stoker or to attempt in any manner to enter into a discussion of the merits of the under-feed system of mechanical stoking as compared with other systems which may be classed as over-feed; but rather to give a story of the necessity which was the mother of the invention, and the history of the development of the first commercially successful under-feed stoker.

To EVAN WILLIAM JONES of Portland, Oregon, alone is due the credit of first inventing an under-feed mechanical stoker that has been successful to a degree almost unknown to mechanical stokers—not only of the under-feed type, but of stokers in general.

The circumstances leading up to the invention are somewhat peculiar, and I am quite sure will be interesting in view of the final results obtained.

In the State of Oregon, where Mr. JONES resided, wood was more easily obtained than any other fuel; hence, Oregon fir was most universally used for power and domestic purposes.

The residents of Oregon—certain portions of which may be

* For other papers on the subject of Mechanical Stokers, reference is made to the Transactions of the Association in papers by EDWARD ATKINSON, Vol. 35, page 40; ECKLEY B. COXE, Vol. 58, page 185; EDWARD ATKINSON, Vol. 53, page 60; BRYON ELDRED, VOL. 67, page 242.

classed as semi-tropical—have all the characterics of residents of semi-tropical countries, particularly in the respect that they are inclined to take life easy and do as little work as possible. The result has always been and probably always will be so far as the furnishing of wood for fuel is concerned, that up to the time of its delivery no attempt had been made to dry the same and consequently it is in a very green state when used. Now, taking into consideration the fact that Oregon fir has a high percentage of moisture and retains it much longer than most other woods, we can readily appreciate the necessity for some means of quickly and effectively drying the wood before using.

Mr. JONES was at the time mentioned, about 1888, president of the Union Iron Works of Portland, Oregon, and was known throughout that section as having more than ordinary mechanical skill. Certain customers of his (interested in the manufacture of paper) found it impossible to keep up steam with the green wood that they were compelled to use. One of these customers took the matter up with Mr. JONES and asked him to devise some scheme by which the wood could to a reasonable extent be dried before it was necessary to use same for fuel.

After giving the matter considerable thought Mr. JONES arrived at the conclusion that the only practicable way was to dry the fuel with the same heat that must be obtained to steam the boilers. After arriving at this conclusion he made up his mind that the only possible way to accomplish the desired end would be to introduce the fuel from beneath the fire line, carrying a fire on top of the fuel itself instead of on the grates that were until that time used.

After making an attempt to introduce the fuel from underneath by means of levers, he found that such a course would not be practicable and he therefore provided a steam ram for the purpose. The wood used was of the ordinary length (four feet) and was forced from below by means of the ram.

After the furnace was once filled with wood (which before steam was obtained in the boilers could be placed in the furnace by hand) a fire was started on top of the wood. The supports

for the wood consisted partially of solid iron plates, and at the rear of the furnace, which was inclined upward, grates were used.

The result obtained was more than had been expected. It was found that an intense fire was created in the furnace naturally at the top of the bed of fuel. This intense heat served to dry the

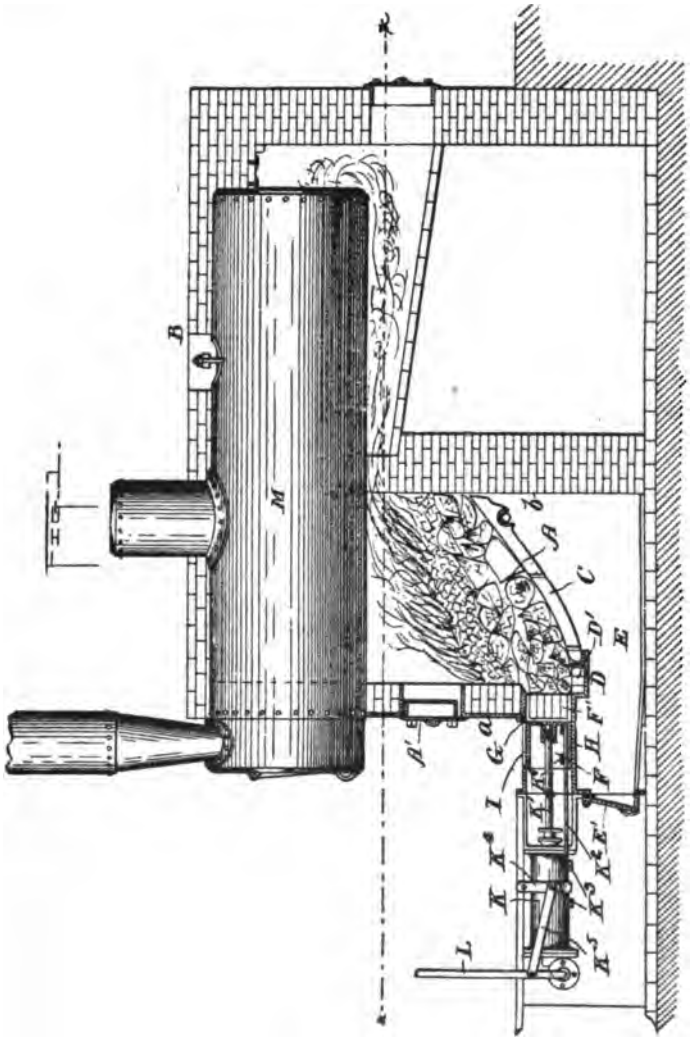


FIGURE 1.—JONES WOOD-BURNING STOKER.

fuel that was beneath the same. In the drying process a considerable quantity of gas was thrown off, the same naturally passing upward was consumed. Therefore the fuel — before being passed into the zone of combustion — was quite thoroughly dried and was in a proper state to give forth all the heat units contained therein.

The illustration on previous page will give you a fair idea of Mr. JONES' invention, which proved to be entirely practicable, and which was used successfully in a number of plants in Portland and vicinity for a number of years; and some of which are probably now in use, although since they were designed coal has been found in the vicinity of Portland that can be used for fuel — and at certain times is cheaper than wood.

Realizing that the field for a mechanical stoker designed solely for the use of wood for fuel was very limited, and that equal if not more satisfactory results could be obtained in the use of bituminous coal for fuel under the same system, because of the high proportion of volatile matter contained in the same, Mr. JONES naturally turned his attention to the devising of a mechanical stoker for that purpose.

The fundamental principle of under-feeding which had already occured to Mr. JONES very forcibly now became a fixed idea in his mind. You are undoubtedly more or less acquainted with this principle, that is the introduction of the air above the fresh or green coal, but below the incandescent bed of fuel, at or about the point where the volatile gases are liberated; which gives a thorough mixture of the gas and air before reaching the zone of combustion and which results in the practically complete combustion and the utilization of the heat of these gases which in ordinary hand-firing is to a great extent lost.

After having made the necessary drawings and after reaching the conclusion that a stoker constructed as shown on the drawings would operate successfully, he obtained permission from the authorities of the Portland Cable Railway in Portland, Oregon, to equip two of their furnaces with his stokers.

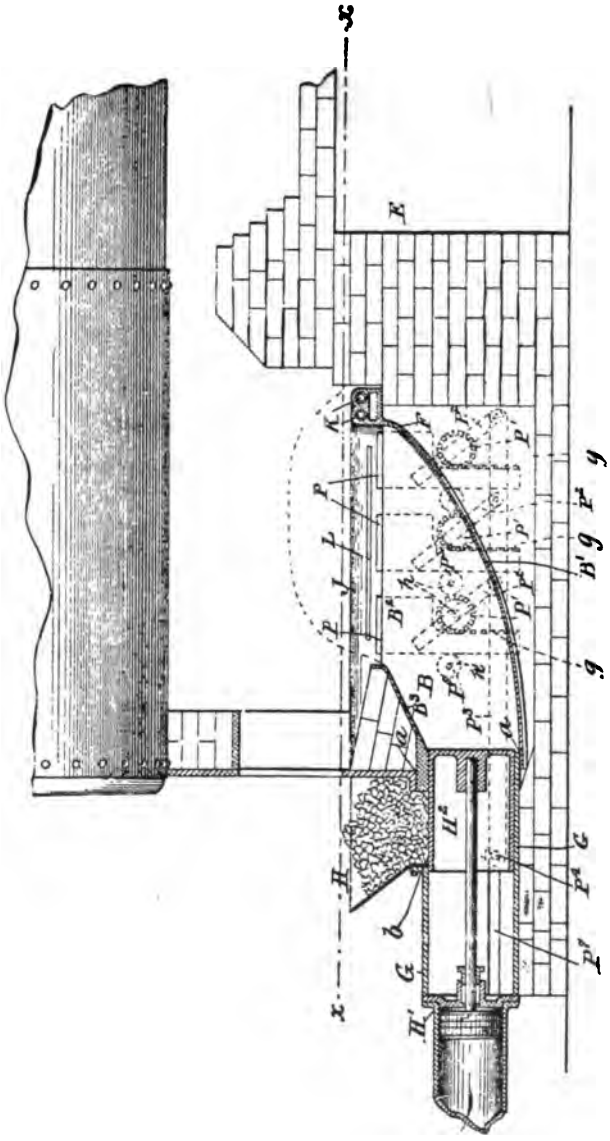


FIGURE 2.—JONES' FIRST COAL-BURNING STOKER.

The stoker first constructed is quite clearly shown above, but the illustration does not show the exact construction as

changes were made from time to time. The sloping bottom support for the bed of fuel will be noted to be practically the same as that shown in Figure 1; a steam ram being used in both cases.

Fearing that with some kinds of coal clinker might form in the retort, a device for removing it was provided as shown.

The necessary air for combustion was supplied by means of an independent fan blower operated by means of an independent engine, the air passing beneath the zone of combustion through the tuyeres, first passing through tuyere boxes located on either side of the stoker and immediately beneath the tuyeres, which tuyeres in the first stoker extended from one end of the retort containing the coal to the other. Fearing that these tuyeres would burn out rapidly, they were protected — at least an

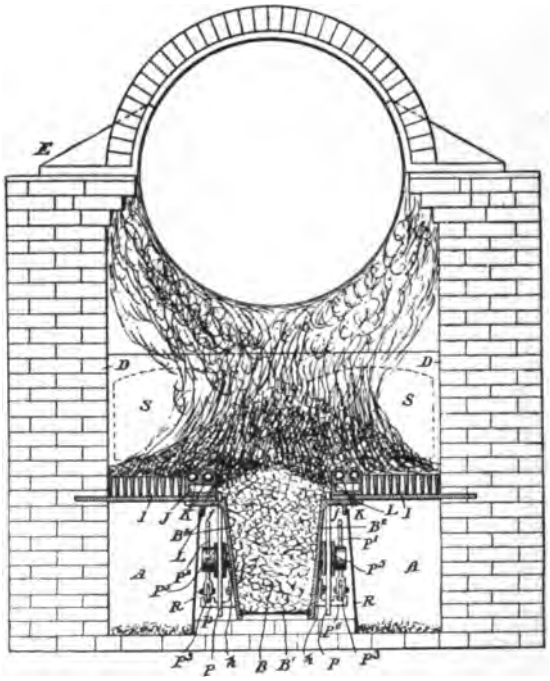


FIGURE 3. — JONES' FIRST COAL BURNING STOKER.
(Transverse Section.)

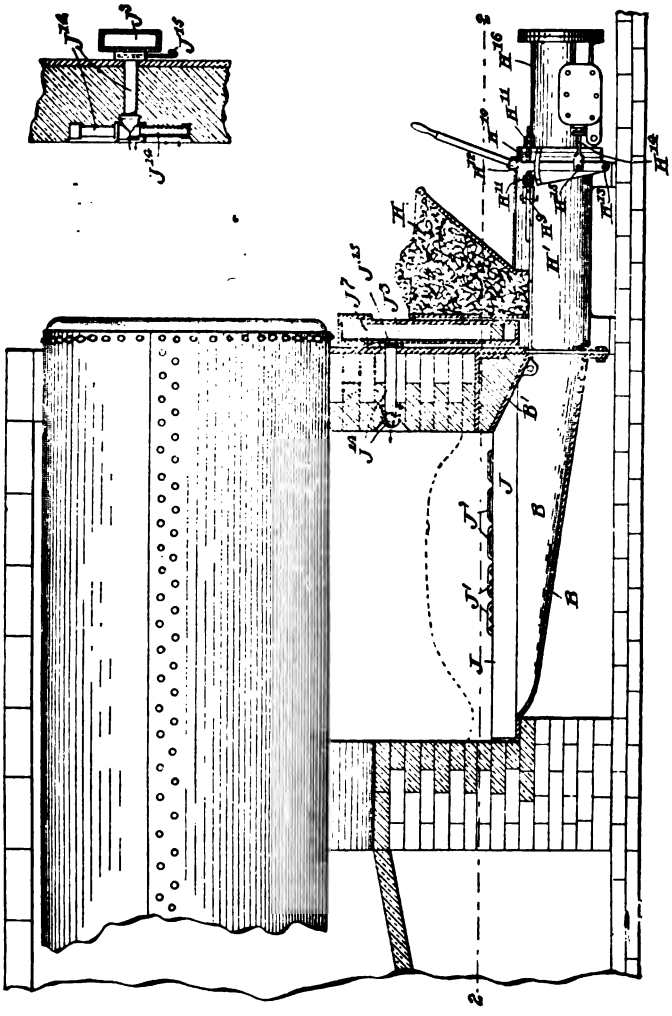


FIGURE 4.—IMPROVED TUYERES.

attempt was made to protect them — by providing two pipes which were cast in the upper portion of the tuyere blocks and through which it was intended that water should circulate.

In actual practice Mr. JONES was greatly surprised to find upon cleaning the fires that the pipes containing the water were destroyed in a very short time, while the tuyeres — protected

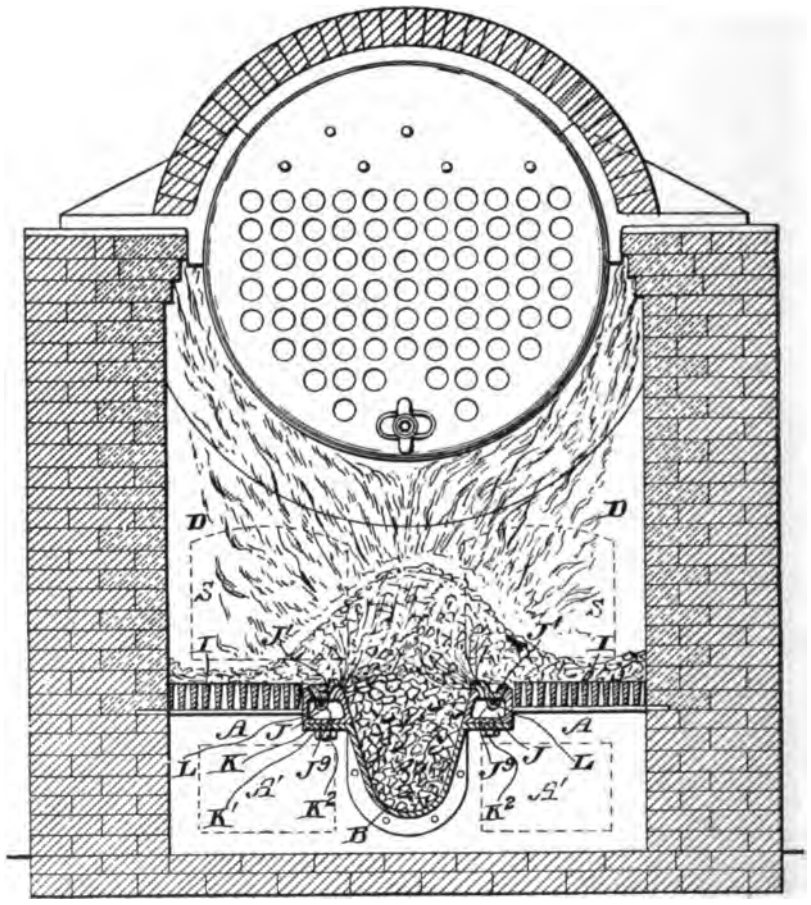


FIGURE 5.—IMPROVED TUYERES.
(Transverse Section.)

by the air which was continually forced through them — were practically indestructible. Such being the case, the use of the pipes referred to was of course abandoned.

The pipes and cleaning mechanism referred to are clearly shown in Figures 2 and 3.

It will be noted from Figure 3 that Mr. JONES at that time thought it would be advisable to use grates on either side of the retort through which air would be admitted by means of the

natural draft of the stack in addition to the air supplied to the tuyeres by means of the blower above mentioned, which tuyeres are also clearly shown in Figure 3.

After a number of changes in the original design the stokers were found to operate very satisfactorily, and a saving in fuel was effected, which gave Mr. JONES reason to believe that a mechanical stoker properly designed and constructed with a view of using the heat necessary for steaming purposes to generate and liberate the gases from the green fuel would be commercially successful.

He therefore continued his experiments and after a short time designed and manufactured in the Union Iron Works a stoker practically the same as that shown in Figures 4 and 5.

It will be seen from the above that instead of using tuyeres extending the full length of the retort he used several tuyeres, it having been found that the long tuyers would in time warp, and after warping would soon be destroyed. It will also be noted that the space through which air was passed to the tuyeres proper was considerably increased over that shown in Figure 3.

Up to about this time Mr. JONES was entirely unfamiliar with the experiments that had been tried by others in the line of under-feed mechanical stoking. The first that Mr. JONES obtained any knowledge of these attempts was when his patent attorneys (he having applied for patents upon his inventions) called his attention to patents which had been granted to others a number of years before he had given the matter any consideration.

After having obtained a reasonable degree of success with the stokers which he had designed and manufactured, it was an easy matter for him to see where others had failed in their attempts to produce an under-feed system of mechanical stoking that could be considered as commercially successful.

Although, as before stated, a number of stokers had been invented and various patents issued, to the best of the writer's knowledge — and he has had occasion to give the matter considerable thought and investigation — there was no under-feed

stoker in succesful operation in the world at the time when Mr. JONES first installed his stokers in the Portland Cable Railway Company's plant, and, in fact, for a number of years thereafter.

About this time Mr. FRED A. DALEY, the present manager of the Under-Feed Stoker Company of America, became associated with Mr. JONES, and to whom the history of the progress made from its conception to its present perfected state is due.

It is believed that you will be interested in the changes made from time to time in the stoker, many of which changes have been made by Mr. JONES himself; others by those who have been connected with the business since Mr. JONES' interest in his invention was purchased by them. Briefly speaking, these changes may be noted as follows:

The shape and length of the retort or fuel magazine shown in Figure 4 it was found could be improved because of the following facts:

Owing to the shallowness of the retort at its rear, coal reaching that point would be quickly consumed before a new supply could be provided.

It was also found that with the limited tuyere area shown in Figure 5 a sufficient supply of coal could not be consumed to properly and economically steam large boilers.

It was also found in some cases that depending upon the ram plunger alone it was impossible to deliver and properly distribute the coal.

Changes were then made as shown in the several illustrations comprising Figure 6.

The retort being lengthened with additional tuyere area as well as deepened throughout its entire length—particularly at the rear—the lengthening of the retort necessitated the providing of other means of fuel delivery. To accomplish the end desired an auxiliary ram was provided, and attached to a bar, and the bar in turn being connected to the ram plunger from beneath.

Originally these auxiliary rams were given the same length of stroke as plunger proper. It was found in practice that it would be advisable to provide means for varying the stroke of the

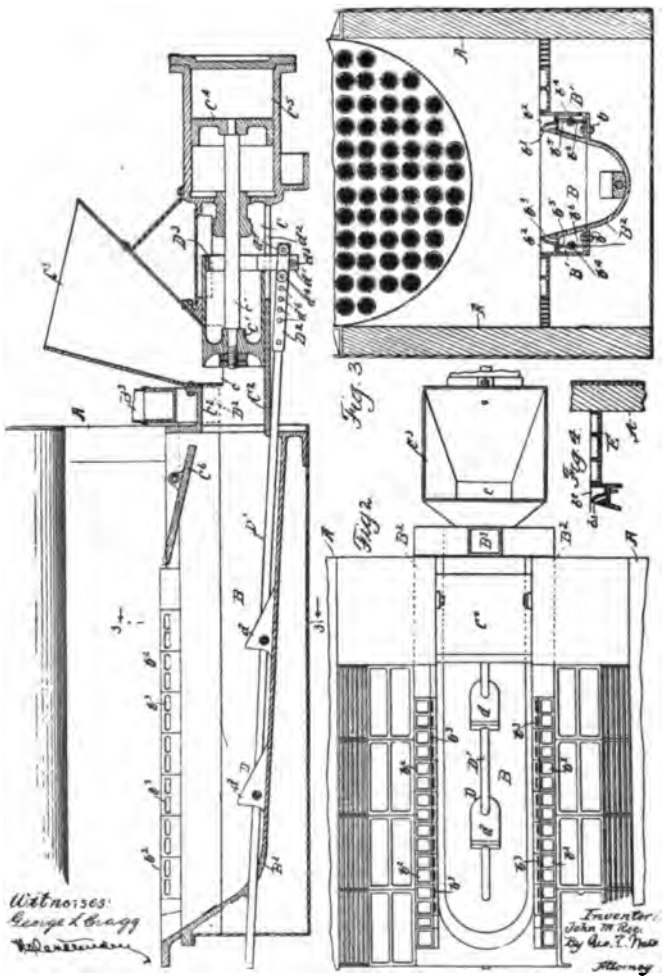


FIGURE 6.
Improved Retort, Extra Tuyeres and Auxilliary Ram.

auxiliary ram, which was obtained in the manner shown in Figure 6.

It will be noted that the area through which air was forced through the tuyeres was again increased as shown in Figure 6. It will also be noted that instead of using grates on the sides of the retort a narrow dead plate was used. It was found that this plate was necessary in many cases where the

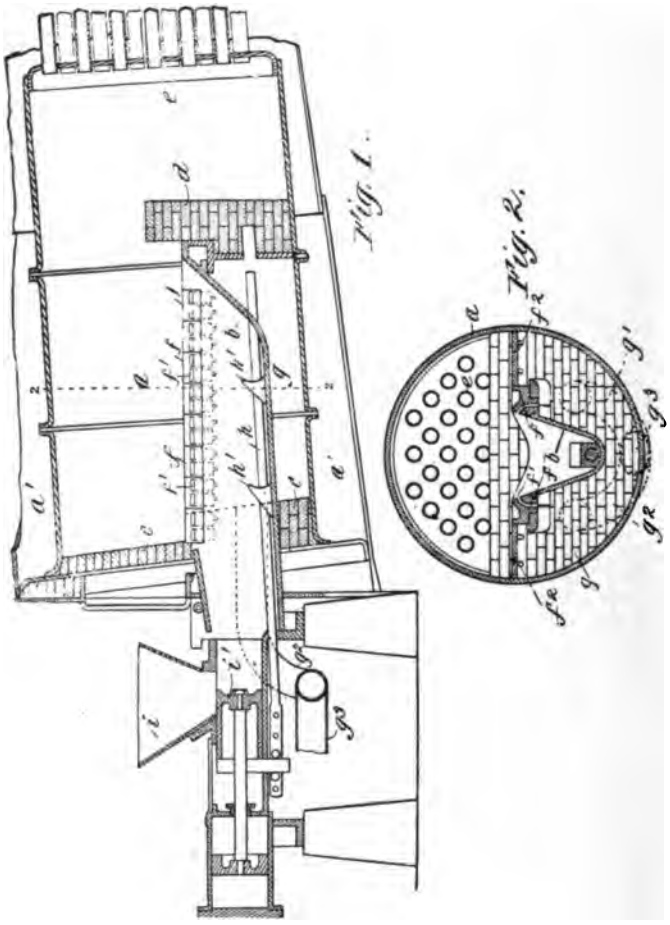


FIGURE 7.
Stoker Applied to Internally Fired Boilers.

natural draft was poor because of the fact that in such cases the air supplied by means of the blower would — seeking the easiest outlet — pass downward through the side grates and out the ash door, thus within a very short space of time destroying the grates.

Later on it was found that the attempt to promote combustion by the use of grates in the furnace did not give the desired result, as the air supplied by means of the independent

FIGURE 8.—SECTION THROUGH RETORT AND DEAD PLATES, JONES STOKER.

blower would effectually prevent the ingress of any additional air through the side grates.

Later on, the tuyere boxes (through which air was admitted to the tuyeres) were deepened on either side of the retort until they reached the floor line.

About this time Mr. DALEY was requested to submit plans for the installation of a stoker in an internally fired boiler. In preparing plans he found that it would be necessary to change the patterns which had formerly been used for the tuyere boxes

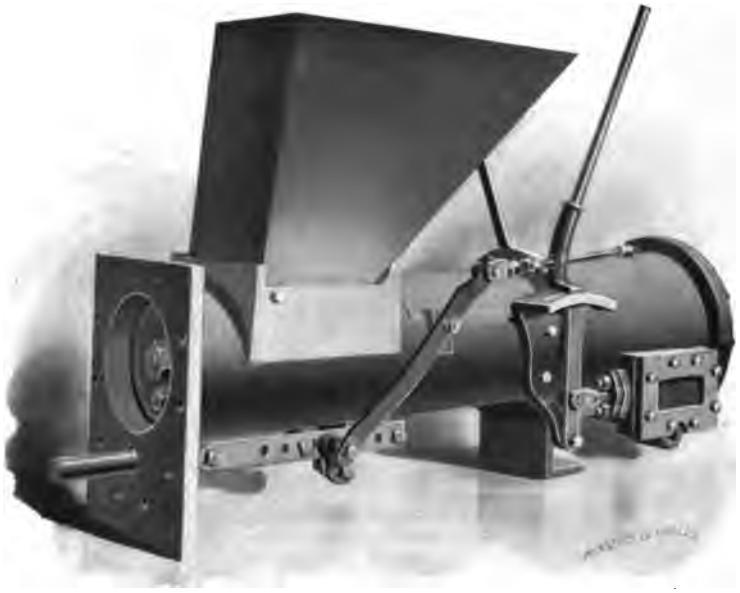


FIGURE 9. — STEAM CYLINDER, RAM CASE AND HOPPER.

last referred to. While considering the necessary changes it occurred to him that it would be preferable to entirely abandon the boxes and use the ashpit as an air chamber.

Figure 7 illustrates the construction used after tuyere boxes were abandoned in stoker as applied to internally fired boilers, which construction was later on applied to all types of boilers and which construction is still used.

Previous tc this time the warping of the dead plates and grates which were used on the sides of the furnace had given trouble. It was believed that by the constantly circulating air under the dead plates this warping would be prevented, and such has been found to be the case. Many of the dead plates which were originally installed from five to six years ago are still in place.

Various other changes have been made from time to time in the design of the stoker, a description of which has been attempted, until at the present time the stoker, it is believed,

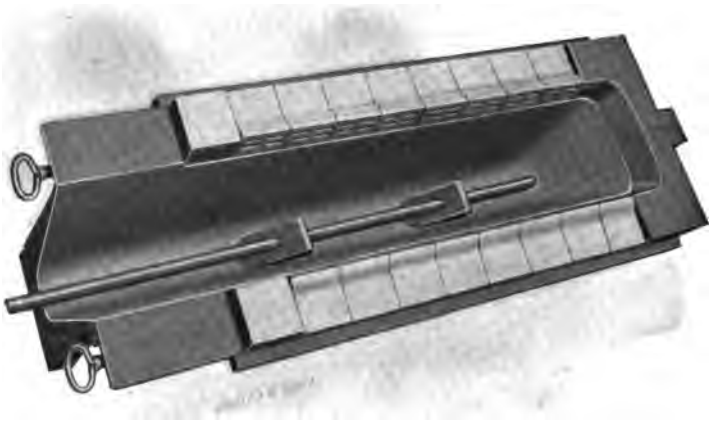


FIGURE 10.— RETORT.

has reached a stage of perfection that has not been attained by any other under-feed stoker.

Figures 8, 9, 10, 11, 12, and 13, illustrate the stoker as now manufactured excepting in a few minor details, including one type of attachment used for operating the stoker automatically.

As has been before stated, at the time of Mr. JONES' invention no under-feed mechanical stoker was in use.

Some five years or more after the installation of the first Jones stoker a gentleman who had been employed in the capacity of sales agent by the company then manufacturing the Jones Stoker, with the assistance of others who were originally interested in the Jones Stoker, constructed an under-feed stoker, the principle of which was identical with that of the Jones — the only material change being the use of a screw for conveying coal to retort instead of the ram plunger that has always been used in the "Jones". This stoker is now being manufactured, and, of course, is in successful operation in many plants throughout the country.

The writer is naturally prejudiced in favor of the Jones Stoker

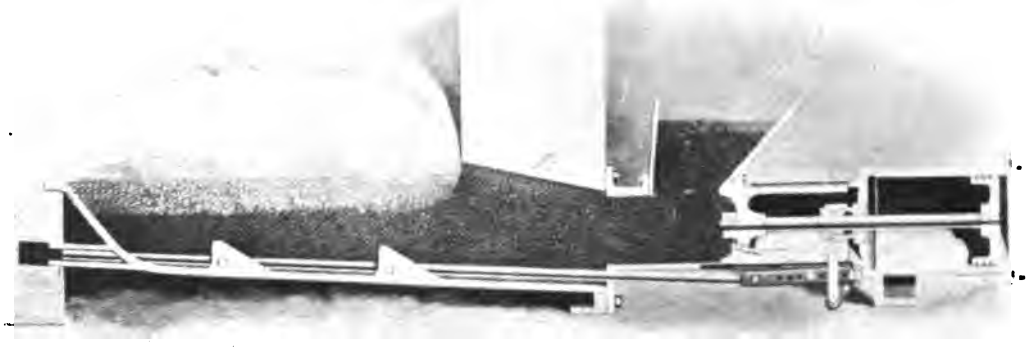


FIGURE 11.—SECTION THROUGH JONES STOKER.

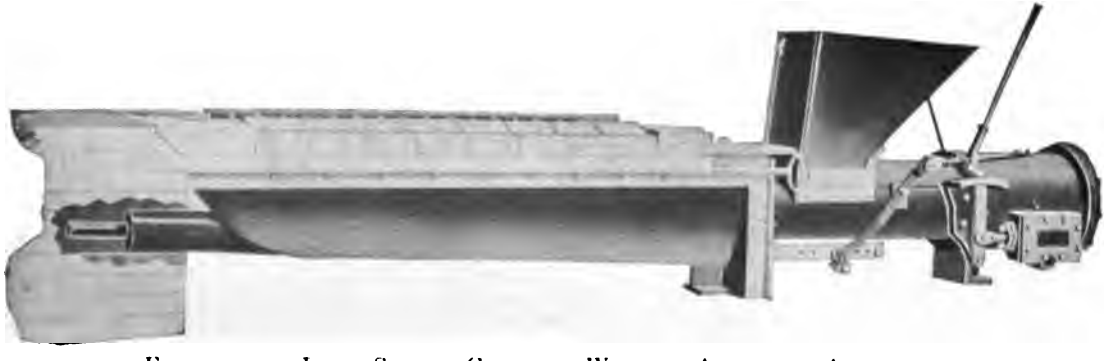


FIGURE 12.—JONES STOKER COMPLETE WITHOUT AUTOMATIC ATTACHMENT.

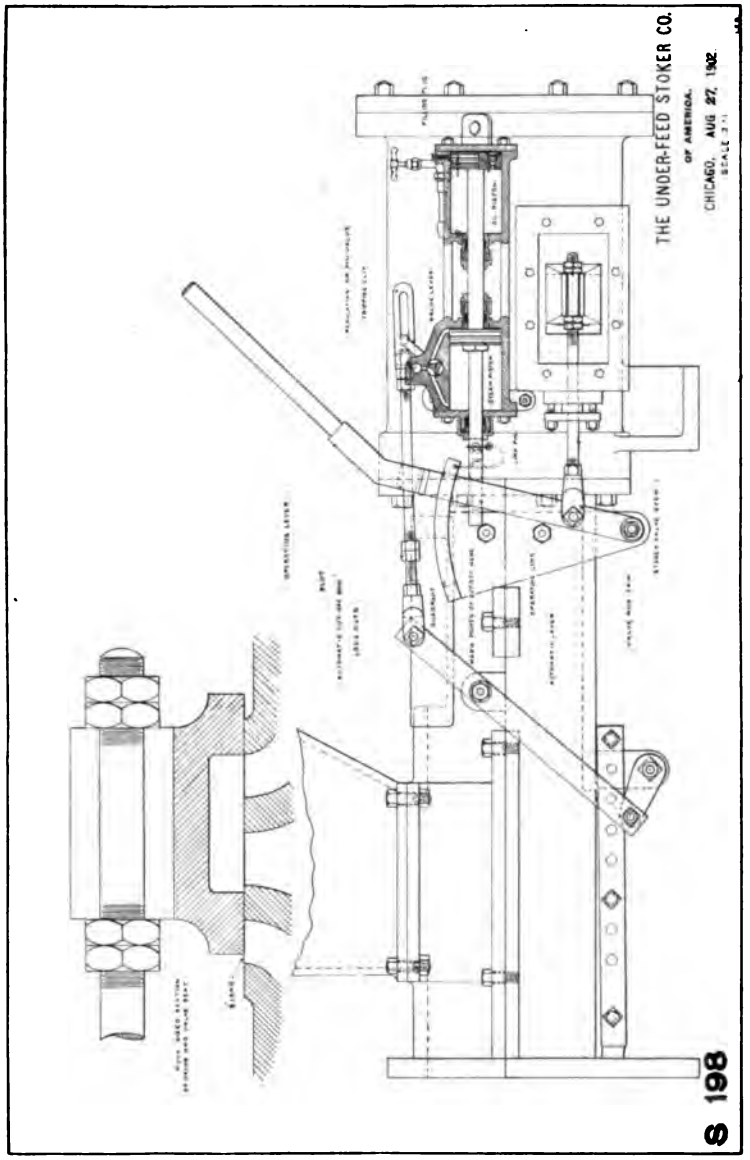


FIGURE 13.—PUMP AUTOMATIC ATTACHMENT.

from his connection with the same and knowledge of its workings. One fact he knows, and that is that in a successful under-feed mechanical stoker it is absolutely necessary to feed the fuel in such quantities at a time as will break the bed of incandescent fuel in and above the retort proper, thus permitting a proper mixture of the air with the gasses that are being liberated by the incandescent fuel in the furnace. This method of feeding insures a lifting motion to the entire bed of fuel in and above the retort, thus assisting combustion by providing for the proper mixture above referred to.

While I have stated that it is not my intention to enter into a technical description of the under-feed system of mechanical stokering, a brief statement of the theory will not be out of place.

Properly operated the system represents a gas producer and gas consumer in one furnace. The green fuel being introduced from the under side of the furnace proper, the incandescent fuel resting thereon must necessarily liberate the volatile matter in the green fuel. Air being introduced at the point where gases are being liberated — this point being underneath the mass of incandescent fuel — a thorough mixture of the air and gases at a high temperature is certain to be obtained. This combustible mixture must pass upward through the body of incandescent fuel and must be consumed. The result is the utilization of practically all of the heat producing elements in the fuel, making more nearly perfect combustion than can be obtained in any other way; and thereby ensuring freedom from smoke.

With an under-feed stoker properly installed, and with a proper air equipment it is possible to obtain a greater boiler capacity than can be obtained by any other system, because of the fact that a proper distribution of coal and air is always maintained, and in any furnace properly equipped the two elements can be supplied in any quantity.

From the writer's experience he believes that an hourly fuel consumption of about 1,000 pounds of coal is as great as should be attempted with one under-feed stoker. Attempts have been

made by manufacturers of under-feed stokers to increase the fuel consumption in excess of this amount, but in the main they have not been, and in the writer's opinion, cannot be successful with all classes of coal. When greater fuel consumption is desired in any one furnace, two or more stokers should be used.

The writer believes that an under-feed stoker properly installed and competently managed can be operated with much less expense for repairs than any other stoker because of its extreme simplicity.

The PRESIDENT. The paper is now open for discussion.

Mr. ALBERT A. CARY. Gentlemen, I have not the honor of being a member of your Association, but have come here merely as a guest. I am much interested in the matter now before you for discussion, having had to do with special furnaces and mechanical stokers for many years and having tested most of the leading ones on the market. I might, however, add that I have never been interested, in a business way, in any of these devices, but have been called upon frequently to apply them to boiler and other furnaces in all sections of this country.

When I received, with my invitation, the first notice of this meeting I found the announcement that a paper on automatic stokers was to be read, so I collected a few notes for this discussion which led me back to a much earlier date than the first one named in Mr. TEWKSBURY'S paper. Seeing, however, that his paper is somewhat historical (tracing the history of this underfeed stoker) it may be allowable for me to go back somewhat further in the history of the development of this class of mechanical stokers, so with your permission, without strictly following the lines of the paper, I will begin with the generally

recognized scientific methods of furnace operation, and then trace the evolution of the coking mechanical stoker, finally reaching the underfeed furnace presented to you by Mr. TEWKSBURY.

It is generally known that with bituminous coal there are three scientific methods for firing boilers which are commonly termed the coking method of firing, the alternate method of firing and the sprinkling method of firing.

In the sprinkling method, if used by a fireman who understands his business, he will wait until the volatile matter from the last charge of coal is entirely distilled off, leaving a hot fire bed of burning coke and he will then sprinkle a new charge of coal evenly over the surface of his fire so as not to choke the openings in the porous coke bed through which the air flows. If he will keep a good clean fire and deliver only small charges of fresh coal at frequent intervals on such a bed of incandescent coke he will obtain economical and comparatively smokeless results, but my experience, however, has taught me that such good firemen are rare, most firemen insisting upon a much easier method of stoking by charging large amounts of coal on the fire at one time at long intervals. This suppresses combustion, produces smoke and certainly does not promote economy.

In alternate firing we find a somewhat easier method for the firemen. To illustrate: We might suppose a boiler furnace containing a bed of incandescent coke burning freely without smoke and two firing doors are provided for this furnace. The fireman begins by charging small quantities of green coal on one-half of the fire bed, say the right half, leaving the left half free from green coal, the air passing freely through its porous bed of incandescent coke. The excess of air thus flowing through this left half of the fire bed will furnish the necessary highly heated oxygen required to complete the combustion of the volatile gases distilled off from the coal on the other half of the bed. After this charge of coal has its volatile matter distilled off, the fireman then similarly charges green coal on the left half of the fire bed and afterwards continues stoking first on

one side and then on the other, which system of firing gives this method the name of alternate firing.

I have shown in Figure 1 the general appearance of the fuel in the furnace when the coking method of firing is used. This method is applicable only to furnaces delivering their products of combustion over a bridge wall located at the rear of the furnace, or else to furnaces having a brick, roof like arch built over the front end of the furnace, which forces the gases distilled from the fresh coal (placed just inside of the firing doors) to travel back towards the bridge wall and thus make these gases pass over the incandescent fire bed in the rear of the furnace. The fire arch setting is required for the coking system of firing with horizontal water tube boilers, and for vertical fire tube boilers, where the freshly distilled combustible gases would otherwise rush directly upward from the recently charged coal among the comparatively cold boiler tubes and become so chilled that combustion would be rapidly suppressed.

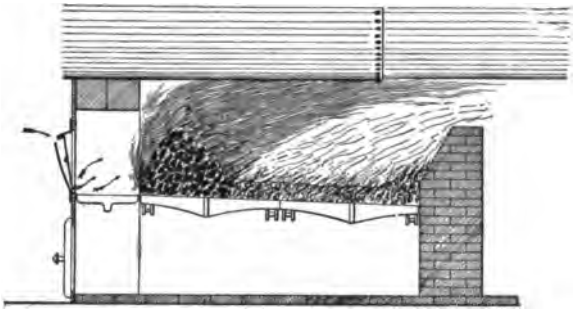


FIGURE 1.—COKE FIRING IN ORDINARY FURNACES.

To describe the coking method of firing let us refer to Figure 1 and let us suppose that the last charge of bituminous coal has distilled off most of its hydrocarbonaceous gases, so that our grate bars are now covered with a bed of incandescent coke. In charging fresh fuel into this furnace we pile it just inside of the door, allowing it to occupy from one-quarter to one-third of the grate's length. This fresh coal is piled so as to extend

across the width of the furnace from one side wall to the other. A slow distillation of the volatile matter from our fresh coal pile then follows, and these resulting hydrocarbon gases are then guided over the incandescent bed of coke covering the rear of the furnace, through which flows an excess of air highly heated during its passage. The air and the volatile gases from the coal are thus mingled at a high temperature, causing rapid combustion in the fire box, which is a most favorable condition for fuel economy and smoke suppression. After most of the volatile gases have been distilled off from our pile of coal in the front of the furnace the fireman pushes this newly formed coke back upon the grates, and this forms a renewed bed of practically smokeless fuel. He then similarly charges another pile of coal across the front end of the furnace, leaving it there until it becomes a coke by losing its volatile gases, when it is pushed back on the grate the same as the previous charge. After the fireman becomes familiar with this method of firing and also familiarizes himself with the action of the coal thus handled, he will obtain, in a properly designed furnace, practically smokeless results and he will find this method no more difficult to follow than any other rational one.

Compared with the ordinary irrational methods of firing by spreading large charges of coal on the fire bed at one time, this coking method will generally show a saving of between five and ten per cent. in the amount of fuel required for the same evaporation.

The principal disadvantage found in this method of firing is due to the length of time it is necessary to keep the firing doors open for stoking and for cleaning. At such times a large amount of cold air rushes through these doors into the furnace, not only checking combustion but chilling the boiler shell and producing more or less harmful strains. This trouble can be somewhat reduced by closing the damper during the time of firing and cleaning, but such practice throws the ash and gases back into the boiler room, making it a dirty and malodorous place, which the firemen naturally object to. But these troubles

may be somewhat compromised by only partially closing the damper.

By continually shoving the coked coal back from the front of the furnace, which of course carries with it all the ash contained in the original coal, when cleaning time comes the fireman finds this refuse in the least accessible part of the furnace, that is, in the rear, which not only increases the work of cleaning, but makes it a long operation, the furnace door being open all the while. This difficulty has been largely overcome by placing a dumping grate at the rear of the furnace, as shown in Figure 2.

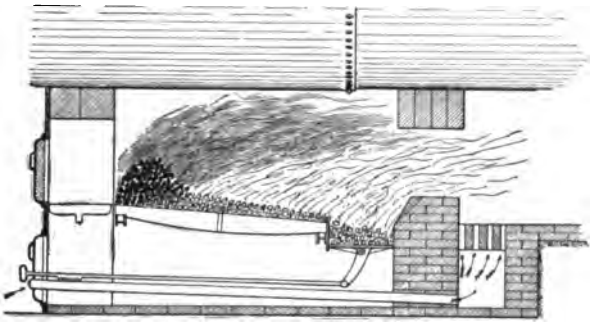


FIGURE 2.—DUMPING GRATE FOR COKE FIRING FURNACES.

With such a dumping grate, the fireman has merely to push the refuse to the rear of the furnace and to dump this rear grate periodically, and by this means we are able to overcome this undesirable feature. This device is not new and it can be used by anyone without restrictions, having been patented by CHANTER in 1843.

To properly charge the coal across the front of the furnace we have seen that the furnace doors must be kept open for some little time. A device was patented in England by LEIGH in 1849 to overcome this trouble, which consisted of a coal hopper placed over the frame of the firing door. A horizontal slide in the bottom of the hopper held the coal in position. When this slide was pulled out, the coal dropped onto the dead plate

below, in a manner similar to that illustrated in Figure 1. This device necessitates a projection of the framework carrying the fire and ash pit doors out into the boiler room. Figure 3 shows

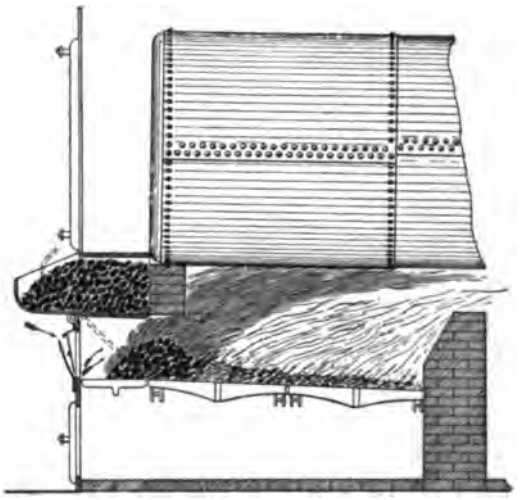


FIGURE 3.—COAL FEEDER FOR COKE FIRING FURNACES.

an application of this kind which is an improvement on the old Leigh device, which was patented in this country in 1894. The coal charging hopper is placed over the firing doors of the furnace and extends from one side wall to the other. After the fireman shoves the coked coal back from the front of the furnace, he operates a lever which dumps the hopper (as shown by the dotted line) thus placing the coal in the desired position in the furnace. The hopper is then tilted back to the position shown in the illustration and refilled with coal and thus is made ready to similarly deliver the following charge of coal to the furnace.

We have now found a practical method for quickly charging our coal to the furnace and another device for dumping our refuse from the rear of the grate, which together do away largely with the objections found to the coke method of firing,

and should we combine these two devices in one furnace, we will reduce the time required for open furnace doors to a small fraction of that required by the ordinary hand firing method illustrated in Figure 1. But even with this combination, we still have our firing doors open for some little time, to allow the fireman to work back the coke from the front of the furnace and to work the ash and clinker back to the dumping grate. To further reduce the labor required, as well as the necessary time for open doors, we must combine these two devices with a method for automatically feeding coal from the hopper to the front of the furnace, combined with an automatic method for feeding it back into the rear of the furnace as soon as it is coked, and further we must devise a method for automatically working the ash and refuse on the grates back to the rear dumping grate, and when we add such features we have developed the automatic stoker depending on the coking method of firing; Figure 4 illustrating one form of such automatic stokers.

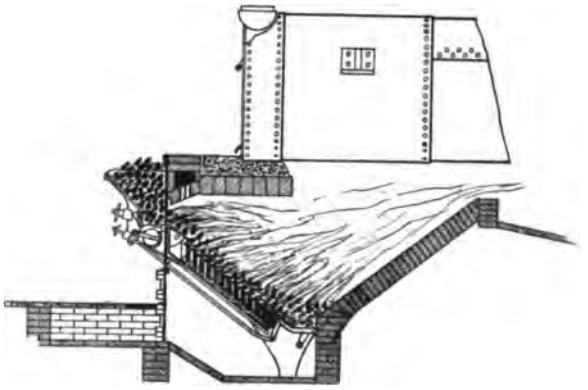


FIGURE 4.—COKE FIRING WITH AUTOMATIC STOKER.

In this illustration we find the coal hopper extending in front across the width of our furnace. We see the necessary mechanism under the hopper for feeding the coal from its bottom into the front end of the furnace, where it is coked, and

we see a number of movable steps, operated by mechanism, which feed the burning coke constantly towards the back end of the furnace, and, finally, when the combustion of this coke is completed, the ash and refuse left behind is delivered automatically on to the rear dumping grate.

This form of stoker is called an inclined grate mechanical stoker and the only difference between it and the hand fired furnace shown in Figure 1 is that mechanical devices are substituted to do, to a considerable extent, exactly the same work that the fireman was required to do by hand manipulations.

From what I have said, you must not infer that mechanical stokers do away with the necessity of having a well paid, intelligent fireman in the boiler room, as this is not so. I have, in a number of cases, found the failures of mechanical stokers entirely due to the owners of such plants placing them in charge of cheap and incompetent men.

When such stokers are kept in excellent repair and operated and humored to suit all the varying conditions found in boiler practice, they will give better results than can be obtained by any hand firing process.

This statement, of course, refers to stokers that are well designed to meet the existing fuel conditions, to those properly proportioned for the work they are expected to do, and further, to those which have the masonry setting about them properly designed.

Another form of mechanical stoker depending upon the coke method of firing is found in the chain grate stoker. The grate surface is composed of what might be considered as a series of small short grate bars, each one of which forms a link in a continuous movable chain. By placing a number of these chains side by side so as to entirely fill the space between the side walls of the furnace, and by connecting these links together, we form a belt of small grate bars, each end of this belt being joined together so as to revolve over two cylinders, the same as a belt in a factory runs over its driving and driven pulleys.

One of these belt cylinders is found (during boiler operation)

running across the rear of the furnace a short distance away from the rear bridge wall, while the other cylinder is found just outside of the front of the boiler, and to this latter cylinder, the driving (or revolving) mechanism is attached. Figure 5 shows a stoker of this kind which was patented in England by JUKES, in 1848.

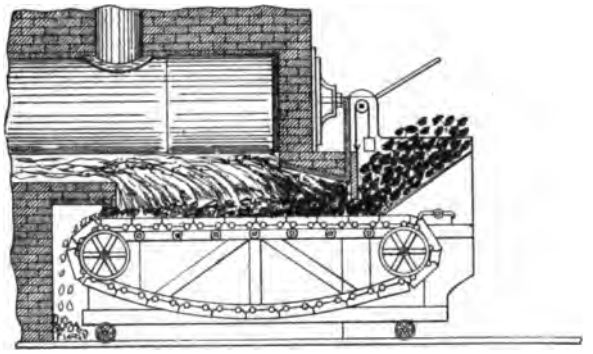


FIGURE 5.—JUKE'S CHAIN GRATE STOKER.

A coal hopper will be seen in front of the boiler just over the outer end of this chain grate, and as the top of the chain moves towards the rear of the furnace, it carries fresh coal into the fire chamber, the amount thus fed being regulated by a sliding gate which is located at the rear of the coal hopper.

As the chain travels very slowly, the coal fed into the front of the furnace has time to have all of its volatile gases distilled off before it reaches the center of the furnace, and from that time the resulting coke allows an excess of air to pass through its porous bed and it burns freely, furnishing the necessary high temperature in the rear of the furnace to quickly consume the gases rising from the freshly fed green coal, as they pass over its incandescent bed on their way to the chimney.

The speed of the grate travel is properly regulated so that by the time the fuel reaches the rear end of the grate, it has been completely consumed and practically nothing but ash and refuse

remain, which fall from the rear end of the grate into the ash pit below.

It will be seen that the entire grate with all its mechanism is placed on a trackway to allow its entire removal from the furnace.

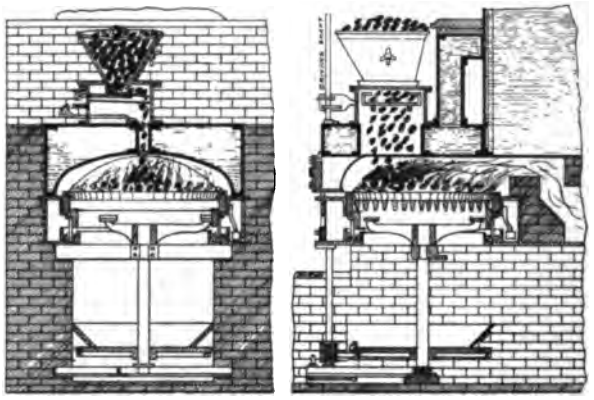


FIGURE 6.—THE BRUNTON REVOLVING GRATE STOKER.

Another form of automatic stoker depending upon the coking method of firing is shown in Figure 6, This was patented in England by Brinton in 1819, and is known as a revolving grate stoker.

It operates on somewhat the same principle as the chain grate stoker, only instead of having its grate travel in a straight line from the front to the rear of the furnace, its grate which is round is placed in a circular fire box and made to revolve around a lower central shaft or spindle.

The coal hopper is placed over the grate in such position as to drop the fuel on to the grate bars, so that the fresh coal will lay in one radical line from the center to the circumference of the circular grate. As the rest of the grate is covered with a bed of incandescent coke, the volatile matter is soon distilled from this narrow pile of fresh coal and rapid combustion of the gases takes place in the upper part of the fire box.

Various methods have been used for cleaning the revolving grate of its ash and refuse, which alone remain after one complete revolution is made (the speed of the grate's revolution being regulated to accomplish this result).

One device consists of a sweep, or metallic guide, which scrapes the ash off the revolving grate just before it reaches the position to receive a fresh charge of coal.

Another device uses a series of sector shaped grate bars hinged at their center and carried on a trackway at their circumference. This outer trackway is broken off, just back of the position where the grate receives its new charge of coal and when one of the grate sectors reaches this end of its outer track, it falls, swinging on its central pivot, and thus dumps its contents into the ash pit below.

As the grate continues to revolve, this fallen sector is raised into position on a cam like guide, which carries it to the normal level in time to receive a new charge of coal.

Now, leaving the automatic stoker temporarily, I will go back to hand firing and trace another system of furnaces depending upon the coking method of firing.

A century ago, JAMES WATT, the inventor of the steam engine, developed a furnace for suppressing smoke nuisance which was partially successful in that direction.

It consisted of an ordinary furnace, similar to the one shown in Figure 1, but near its rear end and just in front of the bridge, he built a vertical wall extending from the top of the grate surface up to the boiler shell. In the bottom of this vertical wall and parallel to the grate surface he placed a row of circular pipe like tiles, which formed the only open communication between the front fire box and the combustion chamber in the rear.

The fire was built in the front of the furnace and as soon as a bed of incandescent coke was obtained, fresh coal was charged into this front furnace and as the hot coke bed entirely covered the pipe like openings in the bottom of the hanging bridge wall, the gases, which were distilled off from the green coal, were forced to plunge down through the incandescent coke and

escape into the rear combustion chamber through these lower openings.

This furnace proved troublesome and expensive to keep in repair and not very economical in its use of fuel.

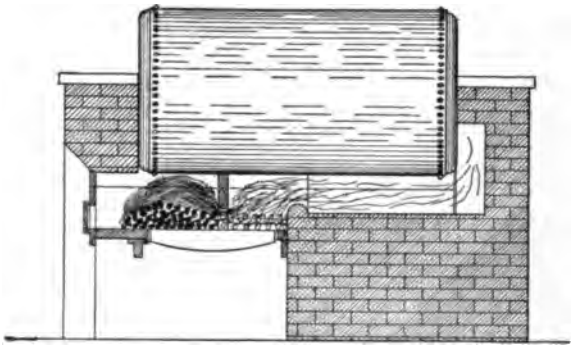


FIGURE 7.—THE RODDA DOWN DRAFT FURNACE.

In 1838 R. RODDA, working on WATT'S idea, patented the furnace shown in Figure 7. The pipe like tiles were done away with, and the hanging bridge wall did not drop down from the boiler to the grate surface. By this arrangement, the coal, after becoming coked in the front of the furnace, was shoved back to the rear of the grates, some being passed under the bridge wall; the distilled gases from the fresh coal being forced to plunge through the fire bed and under the hanging bridge as they passed to the rear combustion chamber. The trouble with this furnace was found in the fact that the burning gases were driven down through the grate bars below the hanging bridge wall, burning them out, while the intense heat under the bridge caused its destruction in a comparatively short time.

These troubles were largely overcome by N. F. B. DE CHODSKO, who patented the furnace shown in Figure 8, in 1862. In this furnace the grate surface, instead of being continued on the same level from front to rear, has its rear portion dropped below the level of the front grates. The burning coke, left after the

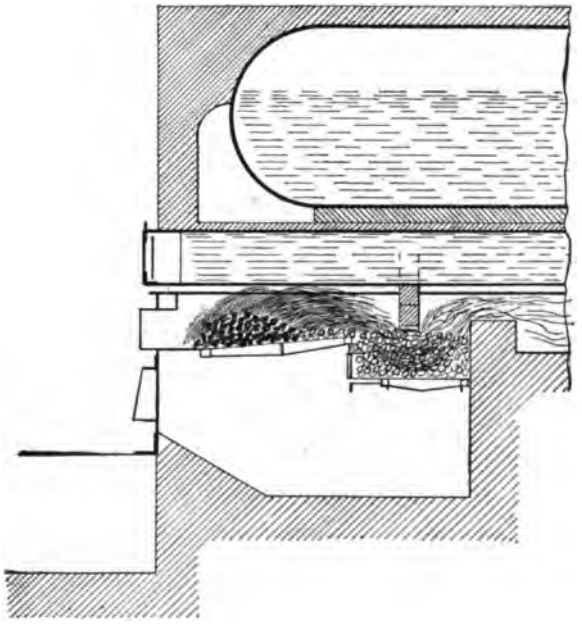


FIGURE 8.—THE DE CHODSKO DOWN DRAFT FURNACE.

gases have been distilled from the fresh coal, is shoved back, covering both front and rear grates and then fresh coal is charged, as shown in the illustration, its gases first running over the incandescent coke bed on the rear of the front grate, and then plunging through the burning bed of coke on the rear grates, under the hanging bridge wall.

This arrangement prevented the burning gases from plunging downward through the grate bars, as they did in the Rodda furnace, and it also provided a larger throatway under the hanging bridge wall, which prolonged its life materially, and it certainly is a very good furnace of its type.

Mr. D. K. CLARK illustrated in his revision of C. WYE WILLIAMS' work on Fuel and Combustion, the furnace shown in Figure 9 which he tested about 1850.

This, it will be seen, is a furnace constructed on similar prin-

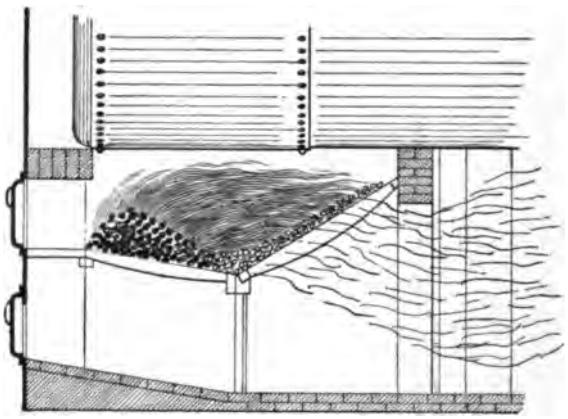


FIGURE 9.— EARLY FORM OF DOWN DRAFT FURNACES.

ciples to those just described. As soon as the coal is coked on the front grate, it is shoved back on the rear inclined grate, and then new coal is charged as shown in the illustration. The gases from this fresh coal rise and pass over the incandescent coke at the rear of the furnace, and then are made to plunge downward through its bed, burning fircely during their passage. The trouble with this furnace was the same as with the Rodda furnace, as far as burning out grate bars was concerned, which trouble prevented its general adoption.

This furnace has a partition running across the center of the grates, in the ash pit, from one side wall to the other, so that all air furnished to support combustion must either pass upwards through the front grates or else through the front firing doors.

We have now considered the prototypes of the modern down-draft furnace, in which the gases distilled from freshly charged coal are made to plunge downward through the incandescent coke bed formed from the previously charged coal.

One of the earliest forms of successful down-draft furnaces, constructed according to the modern idea of such a furnace, was described, about forty years ago, by the inventor, Mr. CHARLES FAIRBAIN, at a meeting of the Edinburgh and Leith Engineers' Society.

This furnace had a grate constructed of fire brick arches (with narrow slit like openings between each arch), to withstand the intense heat of the burning gases which passed through them, and the air was delivered over the top of the fuel bed by a forced blast.

In 1862 EASTWOOD patented the down-draft furnace shown in Figure 10, which, it will be seen, contains two grates, one above the other.

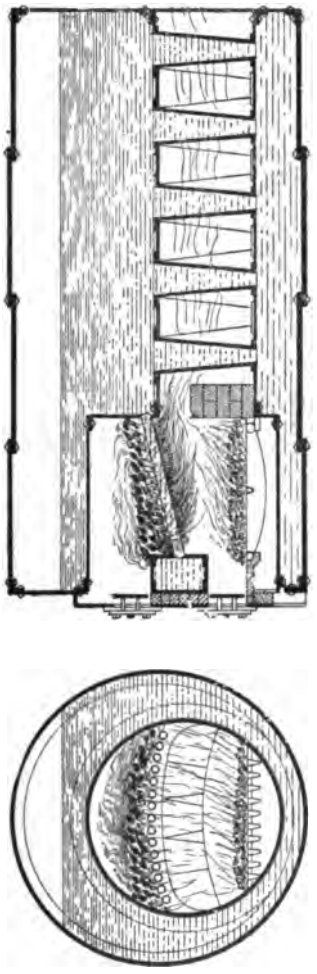


FIGURE 10.—THE EASTWOOD DOWN DRAFT FURNACE.

On account of the rapid destruction of metallic grates used in the down-draft system, owing to the intense heat to which they are subjected, it will be seen that EASTWOOD constructed his upper grate of tubes, through which a circulation of water is maintained, while in his lower or supplemental grate he uses the ordinary cast iron grate bars.

To describe the operation of this furnace: let us suppose that the upper grate is covered with a bed of incandescent coke resulting from the previously charged coal. The door in front of the lower or supplemental grate and the ash pit door are both kept tightly closed, while the upper firing door is always left open. By this arrangement of open and closed doors, it will be seen that all the air entering the furnace passes in through the upper or firing door, and then is drawn through the fire bed by the chimney draft. With the upper grate covered with a bed of in-

candescent coke, we deliver a charge of fresh coal on its upper surface, covering it lightly with an even layer of bituminous coal, taking care that its thickness is not of sufficient depth to prevent an easy penetration of air. As the draft causes the products of combustion to pass downwards, through the grate bars, the combustible gases, evolved by heating the fresh coal, are made to plunge through the hot fuel bed below it and mingle with the air drawn through the firing door, and an immediate and intense combustion takes place, which continues below the upper grates and in the adjoining combustion chamber.

As soon as this charge of coal has its volatile gases distilled off, we have a renewed bed of incandescent coke, on which the following charge of fresh coal is delivered. The water grate supporting this bed of fuel is kept cool, as described before, by the water circulating through it. On account of this grate being constructed of round tubes, some difficulty is experienced in retaining the smaller fuel on it, especially at the time of cleaning fires, and in order to prevent waste of this dropping partially burned coke, a lower grate receives it, upon which its combus- is completed.

At first thought you may be inclined to classify this system of firing with the spread method which I have described, but thinking again, you will see that it is altogether different, being essentially a coking method, as we have to depend upon the heat from our bed of incandescent coke to first, distill off the volatile matter from the freshly charged coal and convert it into a coke, and second, to immediately raise the temperature of these combustible gases to their critical temperature of combustion, and third, to mix them thoroughly with the air which is heated by passing through the incandescent porous bed of coke.

The next logical step in our consideration of this type of furnaces, plunging their hydrocarbon gases through an incandescent coke bed, is the underfed furnace which might also be called an up-feed furnace, being practically a down-draft furnace turned upside down.

In these furnaces, after covering their grate surface with a

bed of incandescent coke, derived from the previously charged coal, we force the following charges of coal upward, from a position below the grate surface, and as this fresh bituminous coal comes in contact with the highly heated coke above it, a rapid distilling off of its volatile gases occurs, and if a proper supply of air is provided to immediately mingle with these gases, both gases and air pass upward through the overlying bed of burning coke, and a rapid and intense combustion follows.

We have now, by successive steps, traced the various developments in furnaces depending upon the coking method of firing, starting with the simplest form of this type of furnace (illustrated in Figure 1), and finally reaching the underfed furnace which has been described in one of its forms by Mr. TEWKSBURY in the paper before you.

I am afraid that I cannot agree with Mr. TEWKSBURY'S statement that Mr. JONES was the first inventor of a successful underfed mechanical stoker, as a number of these have been built and operated successfully in England previous to the earliest date mentioned in Mr. TEWKSBURY'S paper.

Referring first to the wood burning furnace illustrated on page 287 of his paper, which was finally developed into a similarly operated coal burning furnace shown on page 289. I find a very similar development illustrated and described in Vol. 1 of E. PECLET'S work Traite de la Chaleur published in 1860, and have reproduced the cuts found there in Figures 11 and 12, which furnaces were, I understand, invented by St. Clair.

In Figure 11 it will be seen that the wood is rolled down an incline on to the brick hearth of the furnace, and although the logs are not pushed under those burning on the hearth, practically the same results are attained in the way of drying and feeding, as are accomplished in the Jones furnace. There is, of course, danger of jamming in the throatway followed by an interruption in feeding in the St. Clair furnace, which is obviated by the use of a feeding plunger in the Jones furnace, and the use of a grate in place of a unperforated brick hearth is also an improvement; all of the air for combustion in the St. Clair

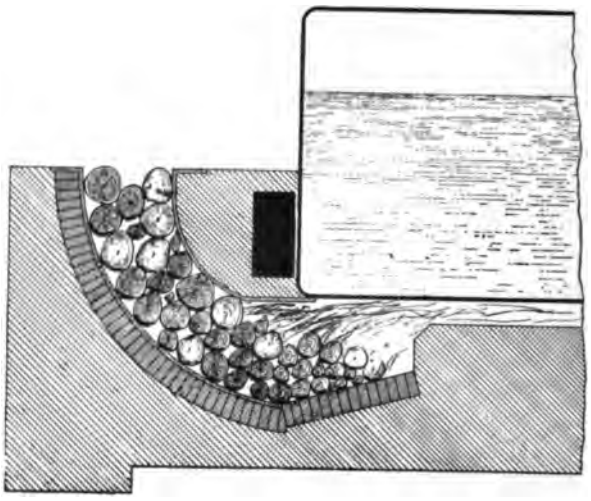


FIGURE 11.—THE ST. CLAIR WOOD FEEDING FURNACE.

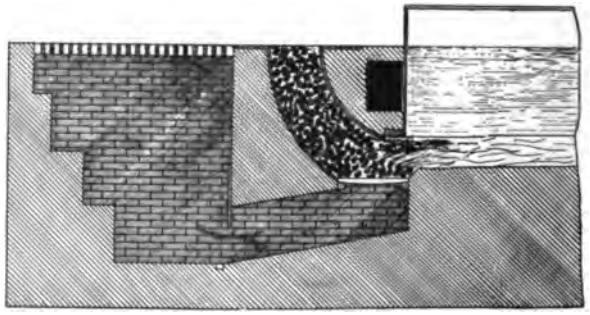


FIGURE 12.—THE ST. CLAIR COAL FEEDING FURNACE.

furnace passing down the throatway through which the logs are fed.

St. Clair similarly constructed a coal burning furnace, shown in Figure 12, which depends upon a top feed of fresh fuel, instead of an underfeed, and resembles, somewhat, the adaptation of one form of gas producer which has been applied to boiler furnaces many times during the past fifty years.

Passing now to a description of the early underfed furnaces we will find that the two mechanisms used for delivering the fresh coal beneath the under surface of the incandescent coke bed on the grates are plungers and feed screws.

In discussing a paper on mechanical stokers which was read in 1876 at a meeting of the British Institute of Mechanical Engineers, Sir FREDERICK BRAMWELL described an underfed stoker which was in operation in 1846, at the Woolwich Dockyard.

This furnace was placed under a wagon type of boiler. It contained a square grate with a square opening in its center through which a square plunger, carrying a charge of fresh coal was made to rise by means of a system of levers. After this charge was delivered under the fuel bed, a flat slide, moving on the surface of the grate bars, was shoved over the opening, and thus made to hold the bed of fuel above it in position, while the plunger was withdrawn to receive its new charge of coal.

This furnace was successfully operated for over a year with very good results as to smokelessness and economy, and its use

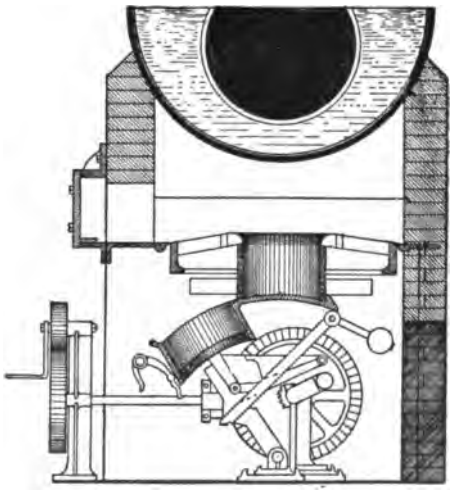


FIGURE 13.—THE FRISBIE UNDERFED STOKER. SIDE VIEW.

was discontinued only on account of the great trouble experienced by the warping and burning of the flat cover slide.

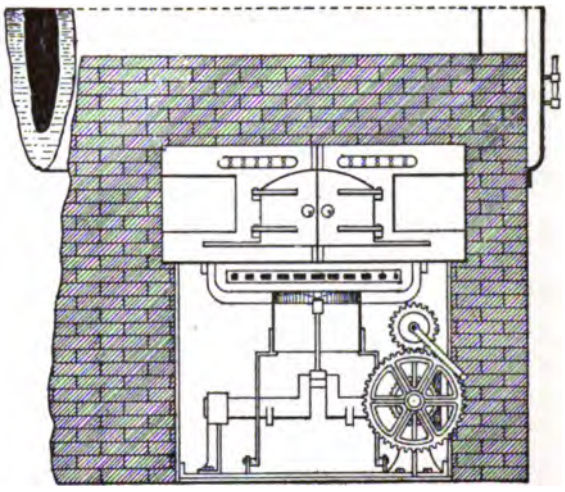


FIGURE 13.—THE FRISBIE UNDERFED STOKER. FRONT VIEW.

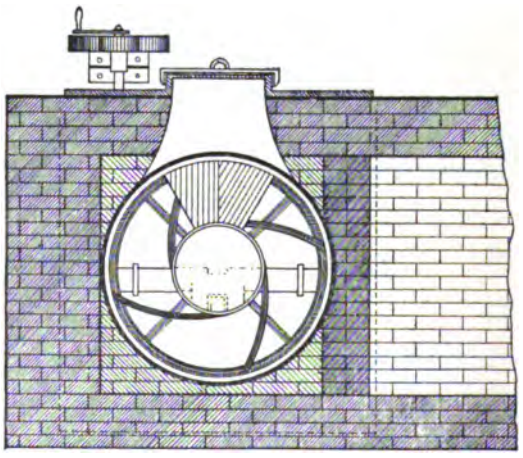


FIGURE 13.—THE FRISBIE UNDERFED STOKER. PLAN VIEW.

In 1868 MYRON FRISBIE patented an underfed stoker operated with a plunger, which was built by Holmes & Walker, of Birmingham, England. This stoker, which is shown in Figure 13, has given very good satisfaction in a number of English plants. The operation of this stoker is somewhat similar to the one I have just described, only both the grate and coal charging plunger are round.

Dropping from the central opening in the grate you will see a cylinder through which the coal is fed upwards into the furnace. Beneath this cylinder a round coal box is placed containing a movable bottom. This coal box is shown tilted forward in the view showing the side elevation of the furnace. When in this position it is filled with coal and then the crank is turned in one direction, which tilts this coal box back, directly under the cylinder opening into the furnace. By continuing to turn the crank, motion is communicated through the gears and levers shown, to the piston forming the bottom of the coal box, which piston rises and thus discharges its coal upward into the furnace above, under the incandescent bed of coke it finds there; and it will then be in the position shown in the front view of the furnace.

When the next charge of coal is required the crank is revolved in the opposite direction, which causes the coal box to tilt forward again; and to prevent the previously charged coal from falling into the ash pit, an apron (shown in the illustration) attached to the rear of the coal box, is drawn across the bottom opening of the furnace cylinder. As we continue to turn the crank the piston in the coal box drops, and then we are ready to fill it again with a new charge of coal, after which we again go through the operation of turning the crank as first described.

To facilitate the easy removal of ash and clinker from the furnace, the circular grate is arranged like a turn table, and revolved by a lever inserted in the openings around its circumference. By this means every part of the grate is brought successively in front of the furnace door and cleaned.

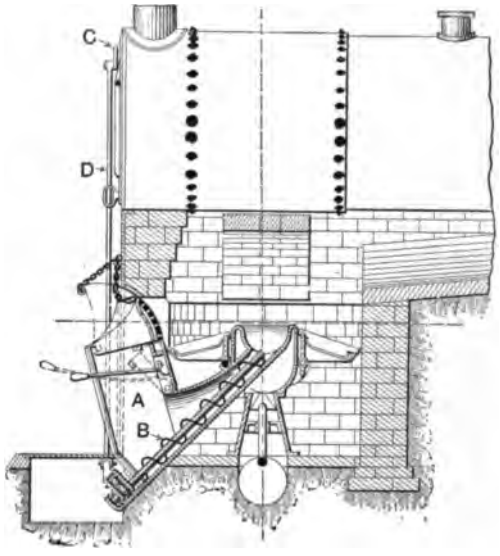


FIGURE 14.—THE WORTHINGTON UNDERFED STOKER. FRONT ELEVATION.

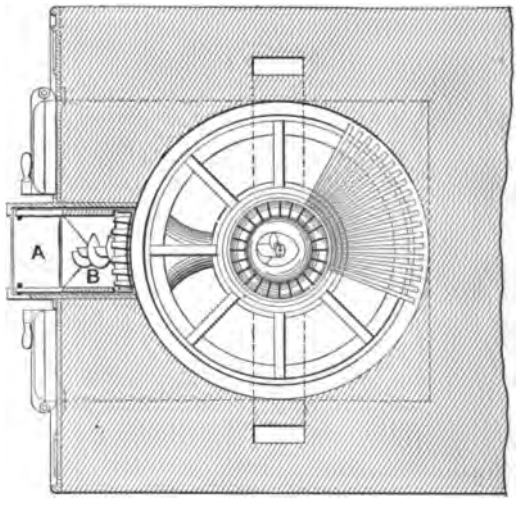


FIGURE 14.—THE WORTHINGTON UNDERFED STOKER. PLAN VIEW.

In 1884 a United States patent was granted to AMASA WORTHINTON for an underfed furnace operated with a conveyor screw, which is illustrated in Figure 14.

By referring to the side elevation it will be seen that a hopper for coal is provided in front of the furnace at *A*, the outer end of the conveyor screw, *B*, is placed at the bottom of this hopper, so that a supply of coal is always resting upon it. The conveyor screw is rotated through successive small angles by a pawl and rachet, this method of feeding being found more desirable than a continuous turning of the feed screw (the former causing the fire bed to rise and fall and so break up the top crust).

At *C* will be seen the revolving shaft which communicates its motion to the feed screw by use of a crank and connecting rod *D*.

At the furnace end of the screw will be seen a bowl shaped casting which receives the coal during its passage from the screw end to the under side of the fire bed. Around the upper edges of this bowl shaped casting will be seen tuyere openings, through which the forced blast of air issues, and then after passing through the fresh coal, it enters the incandescent coke bed above, mingling and mixing with the volatile gases distilled from the coal, and as its temperature is raised to the degree of ignition, combustion follows.

The underfed furnaces thus far considered are what may be called vertical feed furnaces, which have a certain field of great usefulness, but as the stoker presented in Mr. TEWKSBURY'S paper has a horizontal feed, I will now refer to an early furnace delivering its coal in a direction parallel to the grate surface.

This furnace, which is illustrated in Figure 15, was patented in England in January, 1878, by Mr. HOLROYD SMITH, and built by the Helix Furnace Co. of Lancaster, England. It has been in successful operation in a number of plants in England, and it was exhibited at the Paris Exposition in 1878.

The illustration shows a furnace designed for application to an internally fired boiler, such as a Lancashire, a Galloway, or a Scotch marine boiler. By examining the grate surface, it

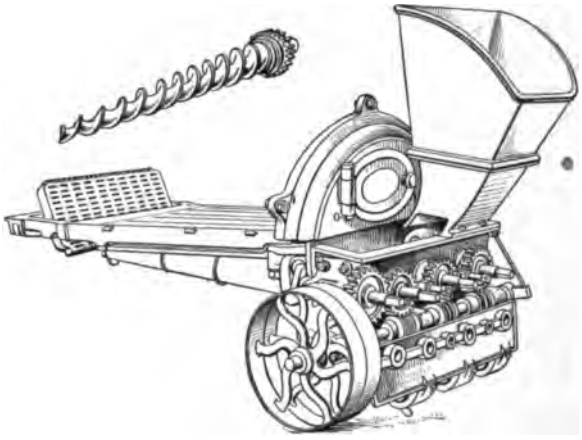


FIGURE 15.—THE SMITH UNDERFED STOKER. SIDE VIEW.

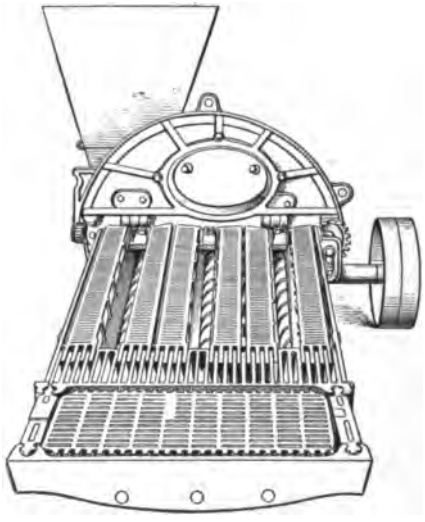


FIGURE 15. THE SMITH UNDERFED STOKER. REAR VIEW.

will be seen that it consists of four narrow strips of cast iron grates (running from front to rear), with three U shaped troughs or retorts (as they are commonly termed) dropping downward between these narrow grates.

These retorts are deeper at their front ends than at the rear and they each contain a tapered screw like feeding device, shown more clearly in the upper left hand corner of the illustration. At the rear of the furnace will be seen a dumping grate. In front of the furnace, a coal hopper is placed at one side to allow the easy opening of the furnace door. The coal contained in this hopper falls upon a revolving cross feeding screw, running across the width of the furnace front just under the furnace door and immediately above the outer end of the three feed screws which revolve in the bottom of the trough like retorts. By this arrangement, the coal is fed continuously from the coal hopper to the three revolving furnace screws, and by them it is carried along the bottom of the retorts towards the rear of the furnace.

As the retort bottoms are filled, and the feed screws continue to revolve more coal follows, the retort is soon filled and then we can stop the operating mechanism while we build a fire upon the normal surface of our grates, which is now composed of the four narrow strips of grate bars, and three level beds of fresh coal between them.

Up to this time the whole working mechanism has been operated by a hand attachment, and our stoking is done by hand firing methods and continued until we have a bed of incandescent coke upon our grates.

By this time, we have steam to operate our feeding mechanism, which is started, and the fresh bituminous coal thus being fed under the bed of hot coke begins to distill off its volatile matter and form a new incandescent fire bed, which allows us to continue operating this furnace continuously. It was found that this method of feeding caused all the ash and clinker to work its way to the back of the furnace, so this was easily gotton rid of by periodically dumping the grate placed there.

The system of worms and gears by which this mechanism is operated is shown with sufficient clearness in the illustration to need no further description, but I might add that any one of the screws can be thrown in or out of gear and thus started or stopped whenever necessary, and by this means the fire is leveled up sidewise.

The PRESIDENT. We will now proceed to the reading of the next paper, Tests on Cotton Yarns, by Mr. GEORGE R. SMITH of Bradford, England. Mr. SMITH is not here and the Secretary will read the paper.

* THE TESTING OF COTTON YARNS.

GEORGE R. SMITH, Bradford, England.

Testing yarns is a subject which is looked upon today by many manufacturers as only suitable for the scientific laboratory where investigations of various kinds are carried on, and not at all suitable to works where the spinning of cotton is being carried on. This kind of feeling is as natural as it is primitive, because it arises through a want of knowledge as to the effect of small matters relating to the spinning of yarns, and a fear that the results obtained by testing would not be worth the trouble taken to obtain them. These men can readily see that a "fine spinner" should test, but they fail to see that a spinner of low counts of yarn should test. This is quite a mistaken notion and probably arises through the fact that he is not compelled to test or exercise the care which a fine spinner bestows on his work. This is no reason why he should not exercise care and seek to know all that is known about the cause of faulty yarns. If a master does not exhibit a desire to produce a high standard of work, his foremen and others about him do not need to seek and study how to produce the best yarn of its kind. Consequently in time it becomes almost an effort or trouble to produce anything but a poor yarn.

Some manufacturers know quite well that it pays to produce an even yarn whatever be the counts, because there is less waste,

* For other papers on the subject of Testing of Cotton Yarns, reference is made to the Transactions of the Association in papers by AMOS D. DOCKWOOD, Vol. 11, page 15; A. G. CUMNOCK, Vol. 18, page 21; CHARLES E. THOMAS, Vol. 34, page 25; ROBERT MCARTHUR, Vol. 34, page 35; SAMUEL WEBBER, Vol. 35, page 31; J. S. LUDLAM, Vol. 41, page 45; A. F. KNIGHT, Vol. 48, page 41; WILLIAM J. KENT, Vol. 52, page 54; JOHN S. ADAMS, Jr., Vol. 61, page 275; FRANK P. VOGL, Vol. 68, page 243; GEORGE R. SMITH, Vol. 69, page 258.

a higher speed of manufacture and greater output. These are not the only advantages, there is another quite as important, *viz.*, to be known as a spinner of even yarn.

Nearly all methods of yarn testing hitherto practiced in England have been based upon what is called an average strength test, because a number of threads (a lea) are tested at once. This testing is done after the thread is spun to ascertain if the thread is of the required strength, and if not strong enough, to bring it up to the required strength by adding a little extra twist. Now long experience on a few counts of cotton and what they should test, coupled with a knowledge that one or two extra teeth in the twist wheel will give the yarn the required extra strength is very good, and this method of testing has enabled the cotton spinner to meet all his ordinary requirements, but this kind of testing cannot be used to investigate the variation of the strength and evenness of the yarn spun, because it does not show small variations in the strength and stretch of the yarn. When we look at each process which has contributed to the production of the thread and consider the possible and probable causes which would effect the spun thread, we begin to realize the scope for and the real use of testing the properties of materials. Now perhaps the easiest and best method, in some respects, is to test the yarn as spun, and immediately the yarn becomes more or less uneven or to have a greater strength and stretch, one should look for the cause of this alteration of the properties of the yarn.

This searching makes one think and observe more closely, and what was uninteresting and seemed to have little in it, now becomes of considerable interest. Personally I think that the first step in such investigation is to learn what not to do and in due time one learns what to do to produce the best work.

It now becomes a question whether closer attention to the details of spinning will repay the trouble bestowed upon the material spun. I know, by the people that do this kind of work that it does pay, or they would not have practiced single thread testing as long as they have. As far as I can see, testing appears to produce the following effects:

1st. The men who are concerned in this investigation acquire a new interest in the spinning processes because they see the effect of small alterations and change of conditions, and do not feel quite so much like animated machines.

2nd. It binds the responsible head and the foremen more closely together as they have one common object in view.

3rd. When the yarn is less faulty the output is greater on account of there being less waste and a higher output efficiency.

4th. The material wears better, looks better and permits a greater rate of output to be attained.

5th. In time one gets a name for good material which means better profits in good times and enough work when trade is bad.

The spinner of low counts of yarn may not see that testing, which means a high standard of perfection, is to his advantage. The general engineer took a similar view of fine measurements years ago, when he was asked to measure to the one one-thousandth of an inch. He thought he would be unable to turn out much work, however, he can turn out more and better work since the introduction of the fine standard, because he has acquired more knowledge, therefore increased power.

The generally accepted notion with regard to the lea method of testing is that it gives the average strength of the yarn. This is not the case and cannot be unless all the threads stretch equally and break together. No one will say that they stretch equally or that they break together. Now there are three methods of estimating the breaking strength by the lea method of testing. Some stop when the first thread breaks, on the ground that this is the weakest thread and represents the working strength of the hank, because the whole is not stronger than its weakest part. Others stop the test when they see two or three threads break, their reason for doing so is that they do not like to trust to one thread. Others let the machine run as long as it will until it ceases to indicate strength on the dial. Which of these methods of testing is the best, is a question each man must answer for himself.

Since this method of testing does not give the average maxi-

mum or minimum strength of the yarn, these results cannot be said to represent anything definite and that no real and serious attempt is made to measure stretch, it can scarcely be considered suitable for measuring by those who are seeking for the magnitude, cause and remedy of faults: because for such work *the results must be absolute and definite*, if otherwise, how does he know whether any alteration is advantageous or detrimental.

The single thread test, when carefully performed fulfils these conditions and in addition shows the effect of small alterations.

It is occasionally urged, by men who have not thought seriously about the methods of testing, that the results of a single thread test only represent a small portion of a hank or cop. This is quite true, and if you stop a lea test when the first or second thread breaks, how much more of the cop have you tested than the single piece of yarn stretching from one hook to the other? It is apparent that an attempt is made to test the whole of the threads on the hooks and that the result is the test of one thread.

To obtain the average strength of the cop or hank, one must make a number of tests and take the average, rather than make one test of a number of threads and call that the average.

The single thread test is superior to the lea test for the following reasons:

It shows the absolute strength and stretch of the thread under test.

It shows how the yarn varies in strength and stretch in each consecutive length tested.

It shows the frequency and regularity of recurrence of faults in the yarn, and thus gives a clue to the possible cause of the fault.

It shows the magnitude of the fault.

Now the variation of these factors are more indicative of the quality of a thread than the average of these tests, because if the material is good, it is more easily made into a good yarn, and if great skill is not exercised to produce good yarns, even good material may yield a poor yarn.

TABLE I.

80's Single Mule Spun Egyptian Cotton, Carded.

Strength in Grammes.	Stretch in inches on 25 inches.	Diameter in Units.	Strength in Grammes.	Stretch in inches on 25 inches.	Diameter in Units.
87	1.2	6	80	1.2	7
120	1.2	7	82	1.0	6
112	1.5	7	104	1.35	7
116	1.4	6	110	1.36	7
112	1.46	6	106	1.4	6
110	1.36	7	110	1.6	7
114	1.36	7	110	1.3	7
110	1.7	7	104	1.3	7
110	1.5	7	110	1.6	7
87	1.26	6	115	1.65	8*
107.8	1.394	6.6	102.1	1.376	6.9

Table 1 gives the results obtained by testing a single 80's mule spun carded yarn and is what the trade would call a very good yarn. The tests were performed in the order recorded, commencing at the top left-hand side of the table to the bottom and then down the right-hand side. From the second to the ninth test inclusive, the yarn is wonderfully even in strength but from the tenth to the thirteenth inclusive it is weak. The length of this weak place is probably three times twenty-five inches, because the lengths tested were twenty-five inches each.

To know how often this weak place occurs and the distance between the weak places is the greatest step towards discovering the cause of this weakness.

The stretch of the yarn is more irregular than the strength but for a *single* yarn it is good. There is little or perhaps no error in saying that the variation in stretch of the thread represents the variation of the distribution of the twist in the yarn. Now to get a clear idea or mental picture of how this can be the condition of the thread, we must first synthetically form in our mind a thread that will give the results we have obtained in this table and then test the thread to see how near it is to the mental

picture formed. We have threads which stretch much and threads which stretch little. Those threads which stretch much have the twist evenly distributed all along their length, and as a result each small portion of the thread stretches and thus gives a large total stretch.

Where the stretch is small, the twist has flowed largely to the smallest place and left a portion of the thread soft. Such a thread cannot stretch evenly because the resistance of the fibres to sliding is great in the small places and small in the soft places, consequently the softest portion of the thread stretches most and the fibres sooner reach their limit of stretch than when they stretch evenly all along the length of the thread. Personally I regard the variation of stretch of a yarn as a very important factor when comparing yarns for quality, or even judging a yarn's possible weaving or knitting qualities. This opinion is supported by tests from the yarns given in Table 2. There is not a great difference in the average strength and

TABLE II.

2/80's Egyptian Cotton.

Sample A. Turns per inch 31. Super Combed.		*Sample B.* Turns per inch 33. Super Carded.		*Sample B' with* 31 turns per inch. Super Carded.	
Strength in grammes.	Stretch in incs. on 25 inches.	Strength in grammes.	Stretch in incs. on 25 inches.	Strength in grammes.	Stretch in incs. on 25 inches.
290	1.34	280	1.32	252	1.3
275	1.45	245	1.22	260	1.3
290	1.52	272	1.36	265	1.3
290	1.5	280	1.38	226	1.1
255	1.45	*225	1.18	245	1.32
265	1.5	275	1.3	*210	1.1
290	1.5	256	1.35	235	1.36
235	1.32	285	1.4	270	1.3
285	1.56	250	1.28	240	1.3
260	1.5	272	1.32	250	1.28
273.5	1.464	264	1.311	245.3	1.266

stretch of these yarns *A* and *B*, nor is the weak place " * " in the *B* sample sufficient to account for the difference.

In the weaving properties between *B* and *A* it will be observed that *B* has a more uneven stretch, hence it has more soft and hard places in it than *A*, which has a very even stretch. It sometimes happens that a thread appears uneven in stretch through the excessive amount of twist it contains, but this is not such a case for when the twist is reduced to 31 turns per inch the evenness of the stretch is not mnch better and the weak place *210 in *B'* corresponds to *225 in *B*.

By reducing the twist in *B* to the same amount as that in *A* we are better able to compare the materials of which the respective threads are made.

The smallness of the stretch " 1.266 " in *B'* as compared with " 1.464 " in *A* indicates that the fibres are possibly shorter in *B* than *A* and the superior strength of *A* over *B* supports this idea. The diameters of these threads are almost equal.

It has already been stated that the amount of twist in a yarn affects the strength and the stretch of that yarn, and that when the twist is in excess of the maximum economic amount, the strength and stretch become less as the amount of twist increases. Now the first sign of the approach of this state is shown by the sudden fall in the stretch as shown in the 2/60 in Table 3, when the extra amount of twist added is ten per cent. of the original twist. This table shows that a little twist over or less than that which the yarn originally contains does not produce a great effect on the strength and stretch of the yarn. This table is instructive in showing us the possibilities of studying the effect of twist. The plus sign + indicates twist added to the original twist, while the minus sign — indicates twist taken from the original. Those cases marked * need further examination to ascertain the cause of this erratic state of things.

Table 4 shows the results obtained from four 2/40's yarn. The first and the third are for the same purpose and are intended to be equal to each other. A glance at the table shows that they are not equal, neither in strength or stretch.

Samples two and four in Table 4 are intended to be of equal quality. Number two would have shown up better had it contained a little more twist. It would have made the stretch a little longer in this case.

TABLE III.

Counts and turns per inch.	Breaking load in grammes.	Stretch in incs. on 25 inches.	Extra turns per inch over (—) or under (+). The original twist in the thread as sold.
2/50's 26 turns	425* 405 400 421 428	2.29 2.08 2.2 1.87 1.71	— 5 per cent. less than original twist Original twist + 5 per cent. to the original twist + 10 " " " " + 20 " " " "
2/40's 24 turns	393 466* 391 410	2.52 2.4 2.4 2.3	— 5 per cent. less than original twist Original twist + 5 per cent. to the original twist + 10 " " " "
2/60's 31.2 turns	232 283.8 298 286	1.84 1.93 1.87 1.62	— 5 per cent. less than original twist Original twist + 5 per cent. to the original twist + 10 " " " "
2/80's 27 turns	202 212 213 218	1.6 1.9 1.46 1.4	5 per cent. less than original twist Original twist 5 per cent. to the original twist 10 " " " "
2/100's 25.2 turns	163 164 165 167	1.12 1.37 1.12 1.0	5 per cent. less than original twist Original twist 5 per cent. to the original twist 10 " " " "
2/20's 1 turn	470 557 644 772 921	1.93 2.2 2.2 2.11 1.69	Original twist. " " 1 turn per inch " " 2 turns " " " 4 " " " " 8 " "

TABLE IV.

2/40's Turns 23.8		2/40's Turns 14.5		2/40's Turns 24		2/40's Turns 16	
Sample $\frac{T\ W}{E}$		*Sample* $\frac{L\ S}{H\ B}$		*Sample* $\frac{J\ S}{B}$		*Sample* $\frac{H\ T\ S}{B}$	
Breaking load in grammes.	Stretch in incs. on 25 inches.	Breaking load in grammes.	Stretch in incs. on 25 inches.	Breaking load in grammes.	Stretch in incs. on 25 inches.	Breaking load in grammes.	Stretch in incs. on 25 inches.
300	1.54	300	1.44	330	1.74	255	1.22
355	1.68	205	1.14	370	1.18	300	1.2
315	1.36	270	1.32	445	1.74	270	1.74
315	1.36	305	1.28	385	1.72	285	1.62
365	1.58	255	0.94	385	1.54	140	0.78
330	1.78	230	1.12	395	1.52	215	0.86
350	1.8	280	1.24	385	2.16	355	1.66
350	1.8	255	1.26	360	1.56	270	1.38
345	1.46	170	1.24	375	1.66	285	1.54
350	1.6	200	0.9	400	1.74	255	1.32
33.5	1.59	247	1.198	383	1.656	263	1.282

Table 5 shows the effect of moisture on cotton yarns. The saturated yarn was obtained by steeping in boiling water, then in cold water, the thread being drawn from the cold water and fixed in the jaws in the machine. The dry yarn was obtained by drying at a high temperature and then quickly transferring from the drying oven to the jaws of the testing machine. The strength of the yarn rises with the amount of water it contains on account of the fibres bending around each other more easily and so producing more "coil friction" between the fibres themselves.

The stretch is a little higher for wet than dry cotton on account of the shrinkage which takes place when the thread absorbs the moisture it contains. The reverse of this is probably the case when the cotton is perfectly dry.

TABLE V.

Counts of Yarn.	Turns per Inch.	Perfectly Dry.		Natural Amt. of Molsture in the Thread.		Saturated with Water.		Kind of Cotton.
		Strength in grammes	Stretch in incs. on 25 inches.	Strength in grammes	Stretch in incs. on 25 inches.	Breaking load in grammes	Stretch in incs. on 25 inches.	
2/20	17.4	617	1.97	774	2.15	671	2.1	
2/24	13.	408	1.5	442	1.63	621	2.14	
2/28	20.3	490	1.8	505	1.94	704	2.66	
2/30	18.6	341	1.67	443.7	2.17	497	1.98	American
2/30	22.0	304	1.59	428	2.04	424	1.7	
2/40	25.	366	1.95	407	1.82	477	1.87	
2/50	23.4	184	1.52	304	1.8	275	1.36	
2/20	20.	431	1.45	470	1.6	695	1.68	carded
2/40	24.	405	1.7	466	1.99	519	2.5	gassed and carded Egyptian
2/50	26.4	329	1.41	405	1.72	446	1.9	" "
2/60	31.2	225.6	1.5	284	1.6	329	1.7	" "
2/80	27.	174	1.37	221	1.6	271	1.5	" "
2/100	25.2	120	1.0	140	1.13	176	2.1	prepared "
2/6	6.	1758	1.84	1926	2.36	2723	2.79	
2/40	12.	495	1.1	555	1.47	590	1.6	Sea Island
2/70	30.	326	1.3	316	1.4	350	1.6	

We have now considered some of the results of testing a few cotton yarns and must now look at the machine on which these results were obtained. Figure 1 is a skeleton drawing of the machine which is shown as a picture in Figure 2. There will be no difficulty in identifying the parts in Figure 2 after a description of Figure 1.

A is the beam jaw of the machine in which one end of the thread is clamped. *B* is the other and sliding jaw in which the other end of the thread is clamped, after being stretched a little by the small weight, etc. By this means every thread can be put in the jaws of the machine, under the same tension, a condition which is very necessary when the stretch of a yarn is

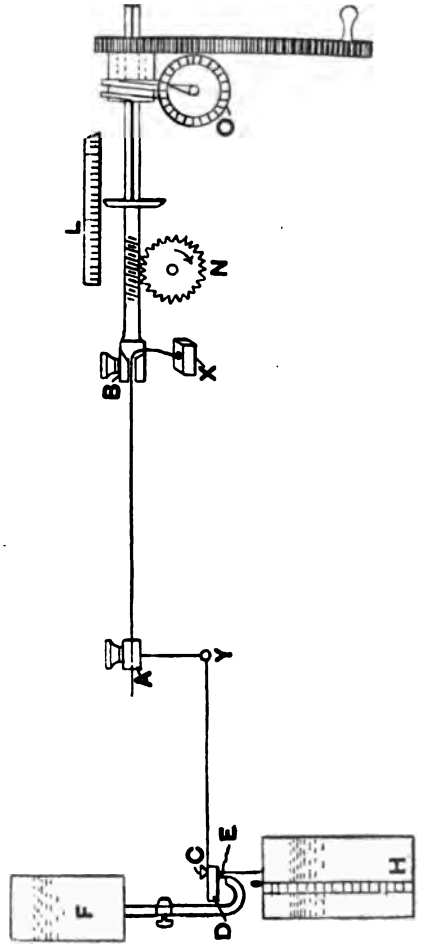
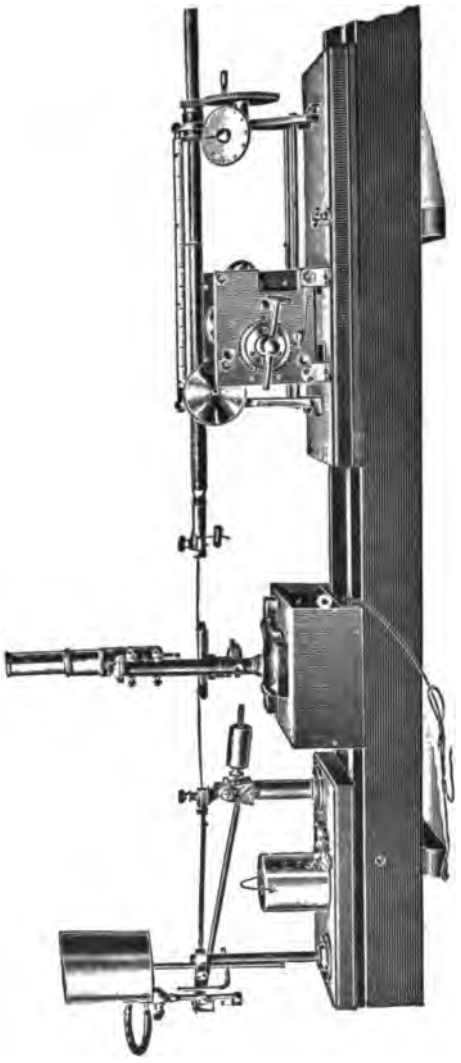


FIGURE 1.

taken into account. Before the jaw *B* is closed the stretch pointer *K* is drawn as far to the left as it will go and it then reads *O* on the stretch scale *L*. After closing the jaw *B*, start the spring motor *N*, which is made to run at a constant speed. This draws back the jaw *B*, which pulls at the thread. The thread pulls at jaw *A* which causes the lever *AYC* to turn about the point *Y*, as this lever turns about the point *Y* with



HYDRAULIC THREAD-TESTING MACHINE.

FIGURE 2.

the pull of the thread at A the rubber pad D is raised from the mouth of the pipe E and water flows from the vessel F into the vessel H, which hangs at C on the end of the lever CYA. When the pull of the thread AB is greater than the downward

pull of the water bucket *H*, the water pipe is uncovered and water flows into the bucket *H* to counteract the pull of the thread. As soon as the thread is unable to bear the load of water in the can, the thread breaks and the pad *D* closes the mouth of the water pipe and so prevents more water flowing into the bucket *H*.

The breaking load in ounces or grammes is then read off from the scale on the bucket *H*.

Immediately the thread is seen to break the motor may be stopped by hand or electrically. The amount the thread has stretched is then read off on the scale *L*.

Twist is added to or taken from a thread by turning the handle *L*. The amount of twist thus applied is indicated in turns per inch on the dial *O*.

The whole of the left-hand portion of the machine from *B* to *L* in Figure 1 which is shown mounted on a board, is capable of sliding on rails as shown in Figure 2. Any length of material can be tested up to 25 inches or more if required by sliding this head to the right on the rails and for finding the twist in a yarn it is slid to the left to a mark on the rails, which indicates that the jaws are 10 inches apart. This is the length usually taken when finding twist in a yarn. You can find the twist in a *single yarn* with this machine in a manner unapproachable by any other machine, because as you take out the twist there is not any tendency for the thread to slacken, consequently you can see when the twist is out of the thread by means of the microscope.

By means of this machine you can fold yarns and thus make a two, three, four or six cord thread and test its strength with any amount of twist in it you please. To fold a number of threads, place and clamp them in the jaw *B*, pass them through the jaw *A* and hang a small weight to each. Then put in what twist you please by turning the handle *L*. The threads now being folded, clamp them in the jaw *A*, remove the tension weights and test for strength and stretch.

The microscope shown in Figure 2 will slide along the rails on

which it is mounted and is always in focus. The thread is most easily examined under a magnifying power of about 60 times. The eyepiece contains a glass scale ruled and numbered, like a measuring rule, in such a manner that the thread is seen to lie across the rule, the numbers and lines on it showing through the thread. The diameter of a thread is affected by the amount of twist put into it. When the thread is very soft, a little twist makes a great difference in the diameter, when moderately hard and very hard, a little extra twist has scarcely any effect on the diameter of the thread. By means of this microscope you can measure the exact effect the twist has produced. By its means you can measure the diameters of threads and thus have an accurate means of comparison of the diameters of threads whatever their color may be. This system of measuring is independent of the hairiness of the thread because the hairs do not count in measuring its diameter.

There is another experiment which is only of scientific interest that can be performed on this machine which I have not seen attempted on any machine hitherto, *viz.*, the determination of the *elasticity* of a thread. The textile trades generally use the term "*elasticity*" to indicate the stretch of a thread up to its breaking, whereas this stretch of the thread should be called stretch.

A thread is said to be elastic when it recovers its original length after the stretching force is taken off the thread, and its degree of elasticity depends upon its power of recovery. Now we can measure its power of recovery as well as the magnitude of the force which makes it pass its limit of elasticity.

The PRESIDENT. We will now take up the reading of the last paper on the programme, as an accommodation to Mr. DENNETT, The Management of Mills, CHARLES W. DENNETT, North Adams, Mass.

Mr. CHARLES W. DENNETT. Mr. President and gentlemen of the Association, although my topic is The Management of Mills my paper has special reference to the matter of the help. I hardly anticipate telling the grave and reverend signors in the mill business anything new, or perhaps the younger and progressive portion of the superintendents and agents, but I hope that some things may be suggested, as I have found it a suggestive topic in writing the paper. Numerous things have occurred to me which I did not think it would be well to incorporate in the paper, owing, perhaps, to its length, but, for instance I would not wonder if at some time we had to have a chair of psychology in our textile schools. Just think of it — if our textile schools were to graduate a man who could analyze the emotions of a tramp weaver when he had been at work about a week and find some remedy to get him over the first pay day without getting drunk, it would be a great benefit. [Laughter.]

THE MANAGEMENT OF MILLS.

CHARLES W. DENNETT, North Adams, Mass.

What are the factors which, combined, make a successful manufacturing concern? There are six, viz: capital, plant, technical knowledge, skilled management, a trained and disciplined body of help, an efficient selling organization. All these are needed to reach the desired objective, that is, a steady, dividend-paying concern. No one of the six factors can say to the others, "I have no need of you," neither can any combination of five say to the sixth, "We have no need of you." Like the human body, they together form an organized whole, and each member is dependent for its fullest usefulness, upon all the others.

Without skilled labor there is no good merchantable product to sell. A trained and disciplined body of help is an iridescent dream, without good management. Good management must be accompanied and supplemented by technical knowledge. Labor, management, and technical skill are helpless without good buildings and modern machinery; and the latter is an impossibility without capital, aud capital is a stagnant pool, useless and dangerous, without the channels of manufacture and trade in which to run.

The purpose of this paper is to touch upon two of the six factors necessary to success. They are, management and help. I am inclined to think that the management of help has not received the attention which its importance relatively to the other factors would seem to demand. Consider the modern battleship, lying gracefully in the water, an epitome of the

mechanical and engineering skill of the twentieth century. Her armor on, her guns in position, her powerful engines installed, ready to propel her, at the rate of twenty knots an hour, to the remotest sea. She represents enough capital to build ten thirty thousand spindle mills. Yet, she is as helpless as a Kennebec bateau, for war purposes, without the man behind the gun, and the skilled officer to direct him.

Similarly, the great cotton mill, with its vast investment of capital represented in its modern buildings and machinery, is helpless and useless without a trained body of help, intelligently directed.

The right management of help in a cotton mill has always been important, and it is daily increasing in importance, and the problem is steadily becoming more difficult. The increasing unrest of the wage earner, not due to low wages but to other causes; the rapidly growing facilities for travel, which enable help to change from one place to another easily; the influence of labor organizations; the scarcity of skilled labor in many departments; all these tax the patience, wisdom and tact of the manager and overseers to the last degree. Furthermore, as strange as it may seem, yet I believe it to be true, that the help in the mills today, are, as a body, inferior to the operatives of thirty years ago. They need more overseeing, more direction. As a whole they are neither as competent, reliable or well disposed as when I was a young fellow working as a common hand in the mill; neither are they as conscientious about doing a fair day's work for a fair day's pay. Immersed in such conditions, the agent or superintendent of the mill must so manage as to keep his machinery moving and meet the demands of his treasurer, directors and selling house, in product and in quality. He surely has no easy task.

Here permit me a short digression, while I say a word for the hard working, much enduring, long suffering, often maligned, frequently misunderstood, mill agent or manager. He is an officer in the great army, employed in the most scientifically and economically conducted industry in the country. Excepting

cotton, his supplies are chiefly bought of trusts and combinations while his product sells under fierce competition in the open market. His business often combines that of merchant, engineer, builder and manufacturer. He stands between the owners, as represented by treasurer and director, and the operatives, who, under his direction, must make the yard of cloth that pays for everything. In good times help is scarce but contracts plenty. He wakes in the night and groans for fear he can't keep his promises for deliveries. In bad times he is the first man to be hit. His cost is too high, he must cut down wages. Then comes all sorts of trouble. He is denounced by political demagogues and notoriety seeking persons, who know as much about the topics they discuss as a Hottentot knows about cold storage. A clergyman set to preach the Gospel, who has neither the grace nor the brains needed in his calling, usually turns to labor questions for notoriety and an audience. He knows nothing about labor either practically or theoretically, but he has a loose tongue and he often uses it to bear false witness against men, one of whom is worth ten thousand such as he, for the material and moral upholding of any community. When hard times culminate in a complete stoppage of work, the operative in his distress, turns not to the political or religious demagogue, but to his real friend, the mill manager. During the depression from '93 to '97, many a manager, who would not ask anything for himself, has come to New York or Boston, to the men who hold the purse strings, and fairly begged them to let him start some work for the sake of their help. During that depression no class of men in New England did more to alleviate distress and find something for the unemployed to do, than the much abused mill agent or manager.

I turn now to a few practical considerations of management. These I will divide into two parts. First, the management of the overseers by the agent or superintendent. Second, the management of the help by the overseers. The object of such management being twofold:—first, as regards results to be obtained in product; second, as regards the general welfare and

contentment of the operatives, through which the first objective is attained. As to both results the management should be a unit, that is, every overseer or foreman of a department should be in full and hearty sympathy with his chief in all efforts to build up a body of orderly, efficient, capable and contented workers. The manager should do his work through his overseers whenever possible. If not an exception, it is a fault when it is done directly. Overseers should be encouraged to work harmoniously for the good of the concern, not for self protection and the concealment of each others' shortcomings. Some managers think it necessary to keep their overseers by the ears, that they may thus become acquainted with all that is going on. I do not believe in this system. It's attendant evils far outweigh its merits, if there are any of the latter. It is also demoralizing to the overseers themselves, as men. I think it may be taken as an axiom, that nothing morally bad results in physical or material good. A far better way of knowing what is going on is to require full daily or weekly reports on all details which, in the judgment of the manager, may be necessary. A proper and reasonable discipline should be demanded and maintained. If an overseer cannot get results when enforcing proper discipline, he surely cannot get them without it. Without such discipline the shiftless and ill disposed help demoralize the industrious and well disposed, until all are alike. Good help desire good discipline, and have a kind of contempt for an overseer or manager who does not enforce it.

Overseers should always be treated with proper consideration. They should never be censured in the hearing of their help. If any order or act of theirs needs reversing or cancelling, it should be done through them. If the help see that their overseer is not respected by the manager, they will not respect him. In general, an overseer should be given authority commensurate with his responsibility. If the agent takes away his authority by undue interference, the overseer will drop his responsibility and his superior will have to assume it. A manager should know when an overseer has reached the limit of his ability. A good

man is sometimes driven out or discharged because of the manager's fault. Either too much is demanded of the overseer or the conditions under which he works are not properly understood. It sometimes happens that an overseer is a first class man in his department, in all the more important matters, but is lacking in some subordinate details. For instance, a man may have good judgment and a thorough knowledge of his work and at the same time be deficient in his method of keeping his accounts and his system of knowing just the condition of each sub-division of his department. It is useless to hammer him. He doesn't like to acknowledge his deficiency and he cannot overcome it. A wise manager will help him out either by preparing a system for him to follow or by giving him a clerk who will keep the business tabulated and in shape, thus saving a good man and earning his gratitude as well.

I have the space to refer to but few of the many details of overseerial management. Without proper discipline no man can run his room successfully. When I was an overseer I had a second hand who had been in the naval service in the Civil War. I called him one day and said, "Mr. ——— there is too much play going on in the room." He gave a scrape of his foot and a pull at his topknot, in true sailor style, and replied, "I know it Mr. DENNETT, them young fellows will skylark, in my opinion the best thing for them is a little touch on the head with a marlin spike." Old fashioned spinners used to strap their boys and cut their hair impartially. I have in mind an excellent spinner, a man greatly respected by all who knew him. Parents who had unruly sons sent them to him to "bring up." His methods were not modern, but they were effective. One New Year's Day he came down in my room, (we were having trouble to keep the help in), "Well," I said, "how did you start this morning, Mr. H———?" "I started badly," he replied, "but I took a strap and went up and down the alleys and got 'em (the help) interested."

The overseer of today must maintain discipline by other and better methods. It is so largely a question of personal influence

that no prescription of methods will avail much. It depends more on the man than the method. To effectively break in and train up green help, an overseer must *know* three things. He must know good work when he sees it. He must know what a day's work or a day's product is. He must know what his help are doing, *individually*. He may take his own methods of ascertaining the facts, but he must know them and act accordingly, or he will not be a good overseer. It is not much use to issue proclamations or put up notices, or to attempt to act upon the help in a mass. Get at the people who do the bad work.

You have 20 spoolers. The total of the waste is altogether too much. It is useless to censure the 20; investigation will probably show that one-half the waste is made by four or five girls. Make your correction there. A few spinners make the bulk of the bad yarn, always — providing the trouble is not back of the spinning. Every competent weaver knows that a small per cent. of the weavers make 75 per cent. of the seconds. Nine-tenths of the bad work in a mill is due to carelessness and inattention, and not lack of knowledge.

It would be presumptuous in me, in this presence, to prescribe methods by which the operative in a mill may be kept contented and satisfied. I will attempt only to indicate a few general principles which, when put in practice, ought to conduce to that end.

Col. CARROL D. WRIGHT, in his report on the coal strike situation, gave as the most fundamental reason for the bad condition of things, the utter lack of confidence between employers and employees. Established confidence between the help and the management is a valuable asset for any company. It is much harder to make trouble when such a feeling exists. To be valuable it is not necessary that it be universal. That is too much to hope for. But if the best help feel that their employers are willing to meet them on common ground and do the best for them that business conditions permit, it is a great point gained. Exact justice to every employee, no matter how small or insignificant, should be insisted upon. Overseers should be required

to use all reasonable patience in explaining matters, where misunderstandings arise. More than one strike has been caused by an arrogant, blundering or tactless overseer. It is not only necessary to be just, it is necessary, as far as possible, that all should be convinced of your purpose. "Let not your good be evil spoken of."

I am not much of a believer in presents. A turkey on Thanksgiving Day represents less than a cent per day for the year, in wages. Pay the man what he earns, but let him buy his own stuff. Take an interest in the general welfare of the help, in unobtrusive ways, and don't expect to be praised for it. I arranged for a free bed in our hospital for any Johnson-Dunbar operative who might need it, and posted a notice to that effect. I was rather anxious to hear what the help thought of it. When in the weave room one day I spoke to a Scotch weaver whom I knew very well. Her work happened to be going rather badly. I said, "Well, Maggie, what do you think of the free bed in the hospital?" "I feel as though I was about ready to go to it," said Maggie. I didn't question any one else.

But aside from sentiment, the doctrine that the interests of the employer and employee are one and the same, should be preached and lived up to in some tangible form. If that could be done, labor troubles would largely cease.

When I was a boy, my brother Menander and myself carried our dinner in one pail. It was our custom to divide the food into two portions, before we began to eat, and the fellow who looked on took his choice. You may be sure that the apportionment was made with due regard to justice.

When we clearly see that strict justice concerns our personal interests, it is very easy to be just. If both employer and employee will enlarge their faith enough to believe that strict justice is always and everywhere for the interest of both parties, then the problem of labor and capital, management and help, will be in a fair way to a happy solution. In many minds the idea seems to prevail, that the matter of doing justly is all on the side of the employer. This idea is false and misleading.

The workman is as much under obligation to do a fair day's work as the employer is to give a fair day's pay, and this same principle runs through all the relations of employer and employee. When this is generally recognized, disputes will be easier to settle.

Amid all the trouble and turmoil and disputes, the law making and law breaking, incident to contests between employer and employee, one great truth stands unshaken and unmoved, viz: That fundamentally, it is a moral question of right and wrong, and it will never be settled by greed and violence on either side. The manager who is impressed with this truth and who is able to educate his help up to the same way of thinking, will be the successful manager of the future.

The PRESIDENT. Gentlemen, this is perhaps one of the most important questions that the manufacturer has to deal with, and it will be in order for anyone to make suggestions or any remarks in reference to this subject which Mr. DENNETT has so ably handled.

Mr. SANFORD E. LORING. Mr. President, will you excuse me if I say a few words on this subject? It is merely to give in a few words an incident that occurred in a mill which I visited a few weeks ago. It was suggested by these few words in this paper, "A few spinners make the bulk of the bad yarn always, provided the trouble is not back of the spinning."

Now the conditions which I walked into in a mill in the city of Nashville where they were making colored denim, such as is used in overalls were briefly these: The overseer was a man who had at heart the physical and the mental interests of his employees, but he was working, if you will excuse me for a little

strong language, in what I call technically a hell hole. I call it so for this reason: that his operators there in the middle of a dark mill were wearing their eyes out trying to see. You can understand then what I had in mind when I read these words, "If the trouble is not back of the spinning." Now that man had the heart and the head to understand that his operators were working under practical difficulties that as he said it, "I want to correct. But how can I get my owners to realize as keenly as I do the horrible conditions under which we are working; the lack of light and the lack of air."

If I could have worked as rapidly in that mill as I could think, I would have punched a hole wherever I could in the walls and let in God's sunlight, which that man wanted. I would have taken the ceilings and the floors and shot them apart, five, six, or eight feet, and given them what that man needed and realized that his help needed, more air. And since the topic is one that lies very close to my heart, as you know from what I have said to you on the subject of mill construction, I merely suggest that that is one of the troubles which are so ably referred to here, "back of the spinning" and which should be corrected.

The PRESIDENT. Has anyone else ideas to offer on this question?

Mr. WILLIAM D. HARTSHORNE. Mr. President, I think Mr. DENNETT has covered this ground so completely that it would be hard for anyone to suggest anything to supplement what he had to say, it has been so well expressed. There is one problem, however, which I meet with, and perhaps some of the rest of you do, which it seems to me needs some solution. I refer now to cases of accident, not simply where the accident has occurred from some fault of the machinery, of course that is remediable in the usual way through liability insurance companies; but there are so many accidents which occur in a mill which are not in one sense the fault either of the mill or of the operators; what are we to do about them? A person may be

mained for life; what is the consequence? What remedy is there that can put the help in a position to take care of themselves? A good many years ago we had in our mill what we called a relief society in which we asked each employee to pay in, I think, three cents a week. We collected it once a month at that time out of the pay rolls. It undoubtedly served a good purpose, but as the mill grew in size the operators became restive under it, were unwilling to contribute and we felt obliged to give it up. Today we have no such system. Whenever any employee is injured we always pay his doctor's bills regardless of whose fault it is; but who is to pay for the time of the operative while he is out? We cannot recover it from the liability insurance companies; we have no right to pay it ourselves. It seems to me that some system of insurance ought to be provided which would take care of cases which were worthy of consideration. I have nothing to suggest, I only ask for information if someone can give it that will lead to some such arrangement as seems to me ought to be accomplished.

Mr. CHARLES H. FISH. I have a case in mind which happened in my own works the day that I left for New York to attend this meeting. A man employed in the jig dye house, which is a new building, equipped with new machinery and new shafting throughout, and which is supposed to be as near right as anything ever is, was working on a jig dyeing machine, and the cloth on the machine back of the machine upon which he was working broke or ran out, and as the machine revolved it spattered the dye liquor all over him. He stepped back to dodge the spatters, and called to the man running the other machine to stop it. The latter was a little slow in stopping the machine, so he pushed back as far as he could to get away from these spatters that were coming, and he pressed himself against a side shaft which ran the line of jigs. This side shaft ran about 70 revolutions a minute, very slowly, was perfectly smooth, and had no set screws. The shaft was two and a half inches in diameter and was clean. He had on a sweater or a thick undershirt. He pushed himself

back against that shaft and kept himself there, singing out for this fellow to stop his machine that was spattering the dye over him. There happened to be some blue dye running in that machine, and he didn't want to get speckled. While he was pushing back against that shaft the shaft nipped his sweater and the first thing he knew he went over. The machine was stopped almost immediately, but probably he went over that shaft from 50 to 70 times, possibly more. He was taken to the hospital badly injured, and I just received this morning in my mail a notice of his death and a clipping from the paper giving the account.

There is a case where no one is to blame. Now the question which Mr. HARTSHORNE raises is a very pertinent one. This man had one leg broken in two places, his thigh was broken, and there was a compound fracture below the knee, and on the other leg there was also a compound fracture between the knee and the ankle. If he had lived it would have been at least three months before he could have left his bed. The man in a way was careless and perhaps the company might be censured for having a shaft anywhere within its premises. But there was absolutely nothing there which would indicate a possible trouble at any time. I think that this particular case, so fresh in my mind, comes very close to what Mr. HARTSHORNE has reference to. What is the remedy? In the first place you cannot undertake to guarantee the prevention of accidents. They happen at all times and in most unexpected ways. And when an operator meets with an accident pure and simple and the company is in no way liable it does seem as if there ought to be some method, some way or some kind of insurance which will take care of that man while he is out and put him back on his feet in the works or somewhere else when he is able to take up his work again. I think that question can be taken up perhaps at some later day by this Association and that we can at least endeavor to formulate some means by which we can overcome that great evil.

Is there any discussion on this paper? Are there any further

motions, or any further business to come before the Association? If not, we will now have a group photograph taken and then we will adjourn until half past two this afternoon.

(A flash light picture of the members and guests in attendance was taken at this point, after which the convention adjourned.)

FIFTH SESSION.

THURSDAY AFTERNOON, OCTOBER 2, 1902.

The Association met at 2.30 P. M., President FISH in the chair.

The PRESIDENT. We will now resume the presentation of the papers. The first paper on the programme is, The Export of Cotton Goods, by Dr. WILLIAM P. WILSON, Director of the Philadelphia Commercial Museum.

*THE EXPORT OF COTTON GOODS.

WILLIAM P. WILSON, Sc. D., *Director Philadelphia Commercial Museum*, Philadelphia, Pa.

The members of the New England Cotton Manufacturers' Association represent such an important interest that one can do no less than appreciate to the utmost degree the honor of an opportunity to participate with them in any consideration of the ways and means to promote the manufacture and sale of cotton goods at home and abroad.

In discussing the subject, the one predominate feature is that we sell annually abroad nearly $300,000,000 worth of raw cotton, and indeed last year that amount was very largely exceeded, while the sale of manufactured cotton in foreign lands was but $31,000,000. The disproportion, gentlemen, is too great. What the value of that $300,000,000 worth of raw material, made into manufactured products may be; what proportion of this increased value represents the employment of labor; what proportion of it the capital invested and what proportion the purchase of supplies, thus nourishing and developing other industries, you, gentlemen, are far more competent to say than any one else. It is likely that the value of the goods made from this raw material would greatly exceed the sum of $600,000,000, for the reason that the $300,000,000 worth of raw cot-

* For other papers on the subject of The Export of Cotton Goods, reference is made to the Transactions of the Association in papers by EDWARD ATKINSON, Vol. 20, pp. 15 and 33; Vol. 21, p. 36; F. A. LEIGH, Vol. 20, p. 57; EDWARD ATKINSON, Vol. 22, p. 38; ARTHUR PARKINSON, Vol. 63, p. 284; CHRISTOPHER P. BROOKS, Vol. 64, p. 227; D. A. TOMPKINS, Vol. 67, p. 96; D. M. THOMPSON, Vol. 68, p. 91; Dr. WILLIAM P. WILSON, Vol. 68, p. 176.

ton we sell abroad furnishes three-fourths of the world's export trade in cotton goods, a trade estimated at $500,000,000, and participated in by this country to the extent of only $31,000,000. It is then very evident that an opportunity exists which has been insufficiently utilized for the extension of the sale abroad of American cotton goods.

We pride ourselves upon our superior labor, and upon the greater capacity of our improved machinery over that possessed by any other nation. We have the raw material at our doors.

Other countries have a handicap in the transportation rates when purchasing their supplies from us. Yet we sell to foreign customers barely one-tenth as much in value of manufactured goods as we sell in raw material. Even little Switzerland sells nearly as much as we do in foreign markets, while Japan sells half as much. But that is threshing old straw. No fact can be better known to you, gentlemen, that despite progress in the Orient, we are still far in the rear as a selling nation in cotton manufactures. If with better equipment than any rival we still sell abroad raw material rather than manufacture goods at home and thus lose some $300,000,000 annually, which might be added to the national wealth, where does the difficulty lie? To my mind, it lies in an insufficient study of foreign requirements and lack of energy in developing the foreign market. It is true that the requirements of the home market for many years past have kept domestic makers busy. That an outlet, however, for increased production only awaits exploitation, is evident from the phenomenal growth of the Southern mills, and the ease with which their product has found a market, particularly in the Orient.

Until recently, and now only in isolated cases, the American cotton manufacturer did not go after foreign trade. His mill output was usually disposed of by a selling agent, and he would let it go at that without seeking himself to develop new markets. In the meanwhile, the English and German producer, with the stimulus of necessity spurring them on, reached out into the world and studied new requirements. They know the

preference of the inhabitants of the Soudan and other darkest Africa. They are familiar with the prejudices of the Chinese and have faithfully observed the exuberant color schemes most favored by the Latin races. In short, they found where trade existed or could be made to exist; they made themselves acquainted with every varying phase of local preference, and they sold the goods. Well content were they to allow American fields to produce the raw material so long as they could absorb the double profit of manufacturing and marketing it.

A change has come over the face of things. We note a decrease in the value of raw material sold abroad, particularly in that sold to the United Kingdom, which decreased $19,000,000 in the last year, although the number of pounds sold was greater; and we note an increase of $12,000,000 in the same time in American goods absorbed by foreign markets. It is true that most of this increase was due to our increased sales in China. The fact is encouraging, however, since the Oriental market is, prospectively at least, the greatest of all markets. Under existing conditions, one-half of our cotton exports last year went to China, and our next largest customer was South America with some two and a half million dollars worth. Lest this fact, however, should be given undue emphasis, it should be remembered constantly that we sold to other countries last year raw materials to the amount of exactly $290,000,000, and lost the profit which would have been derived had it been worked up here.

Perhaps, then, in order that we may appreciate our exact position in relation to the rest of the world in the trade, we may be permitted to look a little in detail into the figures for the fiscal year ending June, 1902.

We imported cotton to the amount of $11,700,000, of which $1,500,000 was from the United Kingdom, something over $500,000 from the South Ameriean countries, and $9,500,000 from Egypt.

We imported cotton goods to the amount of $7,000,000, of which $5,000,000 was from tne United Kingdom; $800,000

from France; nearly $400,000 from Germany; and $550,000 from Switzerland. Besides, we imported knit goods to the amount of $5,000,000, laces, edgings, embroideries, insertings, trimming, tuckings and similar manufactures of cotton goods to the extent of $22,000,000, and various cotton goods, other than cloth, to the extent of $8,000,000. Of this amount we imported $11,000,000 from the United Kingdom; $6,000,000 from France; $10,000,000 from Germany; and $8,000,000 from Switzerland.

In the same year we exported raw cotton to the value of $290,000,000, as against $313,000,000 for the preceding year, a loss of $23,000,000 and a gain of nearly $50,000,000 over the year before that. Of these exports the United Kingdom took $128,000,000 worth; France $31,000,900 worth; Germany $70,000,000 worth; and the rest of Europe $43,000,000, Japan also being a customer to the amount of $9,200,000.

In the manufactures of cotton we exported cloths to the amount of $25,000,000, of which $18,000,000 was uncolored. Our customers for this were, the United Kingdom, $600,000; other European countries, $225,000; British North America, a little under $600,000; Central Africa, $700,000; Mexico, $260,000; San Domingo, $250,000; Cuba, $214,000, and the other West Indies, $240,000; Brazil, $540,000; Colombia, $740,000; remaining South America, $2,000,000; the Chinese Empire, $16,000,000, as against $4,500,000 for the preceding year and $8,700,000 for the year before that. The British East Indies took $570,000 worth; British Australasia, $500,000 worth; the Philippine Islands, $160,000 worth, as opposed to $57,000 for the preceding year and $19,000 for the year before that. Other countries in Asia took $1,000,000 worth; Africa, $400,000.

Manufactures of cotton other than cloth we exported to the amount of $6,000,000, our largest customer being British North America, and next the United Kingdom, with a purchase of $800,000. Germany, with a little under $600,000, followed.

SUMMARY.

It thus appears that for the fiscal year ending June, 1902, our exports of cotton manufactures in total amounted to $32,000,000, for the year before, $20,000,000, and for the year before that, $24,000,000. The falling off last year was due largely to the decrease in the Chinese Empire, our sales there being but $4.500,000, as opposed to $16,000,000 for the year ending in June, 1902.

It is interesting to compare this progressive increase in exports with the decline in value of the exports of raw material, which fell from $313,000,000 last year to $290,000,000 for the year ending in June, 1902. It will not do, however, to attribute this decrease to anything like a corresponding increase in domestic manufactured cotton goods, for while the exports of raw material decreased $23,000,000, the increase in the exports of manufactured cottons was but $12,000,000. The difference is partly due to a slackening of manufacturing activity in manufacturing nations, particularly in Germany, which look to this country for their raw material. This is true despite the fact that our own imports of manufactured goods increased $4,000,000 in the past year ending, June, 1902, the total importations of cotton manufactures being $44,000,000, as compared with $40,000,000 for the preceding year, but the chief cause of the difference was the cheaper price of the cotton, exports being actually larger in amount than during the preceding year.

It has been stated that the Orient is prospectively the richest market in the world for cotton manufactures. With a population estimated to be over, rather than under, 400,000,000, with every inhabitant a user of cotton goods, and with the certainty that increased wealth will accrue through the development of the rich natural resources of China, the possibilities of extension in that direction in cotton goods, as well as in other manufactured goods, are illimitable. It behooves the cotton manufacturer to study this market in detail. The first step is the recognition of existing conditions in China, and the character of the importations, of which three-fourths are furnished by Great Britain.

The total value of the imports of cotton goods in China in 1901 was estimated at $71,000,000. Imports of American drills were more than double those for 1900, and American sheetings increased from 2,312,494 pieces in 1900 to 2,840,518 in 1901. Jeans of all kinds show a decrease — the chief market for these being in the North where conditions were slow in settling down. English sheetings show a heavy decline, and one report assigns as a reason the fact that "they cannot compete in price with American goods of the same make."

Cotton lastings and cotton flannels are said to be increasing in popularity, the latter coming chiefly from America and Japan. The local spinning mills did not exercise sufficient influence on the supply to prevent a large increase in imports of cotton yarns.

The figures as given in round thousands for 1901 are as follows:

Cotton Shirtings, gray, plain,	$7,857,000
" " white, "	5,731,000
" " dyed, "	370,000
" " " figured,	366,000
" " Japanese,	22,000
T. Cloths,	1,335,000
" Indian,	24,000
" Japanese,	410,000
Drills, English,	176,000
" Indian,	1,000
" Dutch,	61,000
" American,	175,000
Sheetings, English,	758,000
" Indian,	4,000
" Dutch,	2,000
" American,	5,498,000
" Japanese,	25,000
Chintzes, furniture and plain cotton prints,	$816,000
Twills, printed,	114,000
Turkey Red Cottons,	487,000
Cotton Lastings, plain and figured,	5,735,000
" Damasks,	92,000
Velvets,	278,000

Velveteens,	$35,000
Jaconets, cambrics, lawns, muslins, dimities,	219,000
Handkerchiefs, (dozens)	166,000
" Japanese,	9,000
Towels,	62,000
" Japanese,	99,000
Cotton Flannel, pieces,	820,000
" " Japanese,	173,000
Japanese Cotton Cloth,	61,000
" " Crape,	59,000
Cotton Goods, unclassed,	838,000
" Yarn, English sounds,	972,000
" " Indian,	25,875,000
" " Hong Kong,	77,000
" " Japanese,	8,134,000
" Thread,	229,000
	$71,777,000
Less excess of cotton re-exports,	28,000
Total,	$71,749,000

IMPORTED IN 1901.

Shirtings, white, figured, brocaded and spotted,	$31,000
Re-exported in 1901,	60,000
Excess re-exports over imports,	$29,000

Japan is showing her ability to take care of herself in the way of manufactures. In 1900 she imported nearly $13,000,000 worth of cotton goods, while in 1901 her imports were but $7,000,000, Great Britain furnishing three-quarters of the entire amount, and our share being insignificant. In South America, while we sold $2,500,000 worth last year, this was half a million dollars less than the year before.

Last year we sold to Cuba only $214,000 worth of cotton goods, while in the same year she bought from other countries more than $5,600,000 worth. That is to say, we supplied Cuba with less than 5 per cent. of her cotton goods, less than we sold to San Domingo, the British West Indies, the British East Indies or Australia. It is less than one-fourth as much as we sold little

Porto Rica, and less than one-half what we sold Chili, a country remote, difficult of access and little inclined to cultivate intimate relations with us. With Cuban reciprocity and a little effort on the part of American manufacturers, a big trade could be developed with the people of that island.

It will thus be seen that while there may be a gradual increase in the market of South America, the market in Japan is likely to disappear through increase of home production, while China offers an increasingly widening market and in this direction we may expect to see the efforts of the great manufacturing nations redoubled. It will be necessary for the American manufacturer and the American merchant to be as alert as their competitors. Both Germany and Russia are looking forward to the time when they may secure cheaper cotton supplies from the fertile plains of Southern Russia. No trouble will be spared, and markets will be secured wherever possible. The consumer will be brought in closer touch with the producer, and local preferences will be even more closely studied.

We must meet this activity with equal activity. American trade marks must be the synonym of superior excellence. We must have our own international banking facilities — a beginning of this kind has been made in New York. We must have direct and commodious transportation — that is being provided by a trans-continental line which is placing on the Pacific the greatest freight carriers in the world. We must study more closely local requirements and prejudices through the sending of competent representatives to the spot; beside this, we must avail ourselves of the unselfish help which competent organizations may render. Such aid has been given by the Philadelphia Commercial Museum, of which I have the honor to be Director. It is the expectation and the hope that this aid will be even more extensive in the future. An exact study of the conditions prevailing, made at intervals by expert representatives of the Commercial Museum, will continue to place before American manufacturers of cotton goods a mass of information regarding opportunities of value.

At the risk of seeming unduly self-appreciative — a risk assumed because the results accomplished, if taken advantage of, will redound to the benefit of all American cotton manufacturers — I may be permitted to refer to one feature of the investigations carried on by the Commercial Museum along the lines indicated. It is known to many of the gentlemen present that a trade mark is of vital consequence in China. Individual idiosyncracies or racial prejudices may be of such a character in China that a trade mark would easily infringe upon one of them and render impossible the selling of the goods bearing that particular mark. On the other hand, should it conform closely to the peculiar habit of Oriental thought, it may have as much to do with the sale of a particular line of goods as the excellence of the wares themselves. Realizing this fact, the Museum, with considerable expenditure, secured the services of a Chinese artist and a Chinese merchant to paint in proper colors typical emblems, suitable as trade marks, covering every branch of commerce with China. The result is embodied in volumes which it will be a pleasure to exhibit to the members of the New England Cotton Manufacturers' Association. The intention is to permit any American manufacturer to select one of these trade marks as his own for reproduction in colors. Attached to his goods, it will only remain for him in order to develop a market to make this trade mark throughout China a synonym of surpassing merit.

Not only in this, but in every other way possible, the Commercial Museum is ready at all times to make itself of value to American Cotton Manufacturers. Our aim, like yours, is the extension of American commerce. Under that banner, standing shoulder to shoulder, meeting all competition with even greater effort and intelligence, we can look forward to steady progress in the conquering of the most distant markets, until we shall place the standard of commercial supremacy, supported, not alone by King Cotton, but by every other product of our varied industries, upon a height which no other nation may hope to attain.

The PRESIDENT. We will now proceed to the reading of the next paper, Cotton Mill Expansion, by Mr. ARNOLD B. SANFORD.

Mr. ARNOLD B. SANFORD. It is very evident to my mind from the subjects of these articles that our worthy Secretary is bound to capture the foreign trade, for we generally hold him responsible for all topics that are presented here, and we have had some very admirable papers. I refer particularly to Mr. S. N. D. NORTH on The World's Supply and Consumption of Cotton, and, secondly, to Mr. O. P. AUSTIN on Our Foreign Commerce in Cotton Goods, and thirdly, to the paper just read on The Export of Cotton Goods. Of course I knew nothing about the character of these papers, so I clash with them just a little in the one that I have prepared. While they point the way for us and tell us just what is to be done, yet there remain some very important things for us to accomplish, and that is what I am going to try to point out to you in this paper which I am to give you on Cotton Mill Expansion.

COTTON MILL EXPANSION.

ARNOLD B. SANFORD, Boston, Mass.

The topic assigned to me is one full of interest to all engaged in the cotton industry as well as to the commercial world at large. "There is a destiny which shapes our ends, rough hew them as we will." The United States is now moving rapidly forward for greater development for the expansion of her industrial and commercial interests. The tension of the forces now at work cause the very atmosphere to throb and vibrate under the tremendous pressure and activity pressing toward a larger volume of business.

The opportunity is ours and is before us, but in order to secure it, several factors must be expanded, new methods introduced, every economic factor brought to bear for all it is worth, if we are to win in the great race for commercial supremacy between the nations which are now contending for the foreign trade of the world.

We are living in an age of great progress and every kind of business of any magnitude is undergoing changes. Evolution seems to mark the course, changes occur in rapid succession to increase production and reduce cost to the lowest minimum.

Our topic, cotton mill expansion, confines us to cotton manufacturing, which brings us immediately to industrial evolution, which simply means economic development in modern business.

In order to treat this subject intelligently and concisely, we will range it under several heads.

NEW METHODS.

The problem constantly before the cotton manufacturer from early morning until night is, how to increase production and reduce his costs, and if he should live to be as old as Methusaleh and keep in the mill business, he cannot solve the problem, which will keep him figuring until the last day he is in service, and when he steps out someone else will take it up where he left off.

Remember the world moves, competition is growing keener every day and we cannot afford to ignore anything which offers economy over present methods — the progressive mill man will always lend a willing ear to anyone, who can show him a saving over what he is now doing.

A remarkable event has recently taken place, I refer to the visit of the members of the Textile Manufacturers' Association of Lancashire, England, to inspect and investigate our cotton mills. Fifty years ago we were scarcely known in this industry, England practically controlled the business of the world. These gentlemen came here to look us over, and find that we have grown more than they conceived or dreamed of. They know very well that we are reaching out for their markets, which they have controlled for so long a time. They found one factor here worthy of notice and serious consideration; we refer to the Draper Company's wonderful loom, the Northrop, and we understand as a result of that visit an order has been placed for 500 to be shipped abroad. The Drapers, with their characteristic business sagacity have made the most of the impression and have hastened across the seas; it is now announced a strong company has been formed with the Drapers interested to equip a large plant in England for the manufacture of these celebrated looms. This we consider a great triumph for our American inventors, and the Draper Company are to be congratulated for their success in developing this marvellous piece of machinery and overcoming almost insurmountable obstacles in perfecting and introducing same.

GREATER SPEEDS.

Following upon this we are on the eve of higher speeds for all kinds of machinery which goes toward the equipment of the mill plant, from the picker room to the finished product or last process. The rotary spinning ring hss been attracting our attention for high speeds in spinning. Now we hear of the Marshall patent spinning frame. One of these has been placed in a Fall River mill. The inventor claims it has improved supports for the rotary rings and a new arrangement for oiling, the aim being high speeds with slight friction, and also more even spun yarns. He claims an increase of 33⅓ per cent. in production on our present spinning frames.

To show the wonderful strides in invention, I call your attentian to the controller on the electric car. If you have never noticed this and will take the trouble to do so, you will find on examination of same that it has cast upon its face a record of thirteen patents, the first bearing date August 14th, 1883, and the thirteenth, March 26th, 1895. This in itself is an object lesson of the wonderful progress in mechanics and inventions. Suppose the General Electric Company had been satisfied with controlling this patent for the first four or five issues and shown no more interest, feeling secure, you can imagine what would have been the result! Some one else would have controlled a better invention today instead of the General Electric Company.

So I contend that the successful mill manager of today must be keen to look into and consider any invention or improvement to make better work and more of it at a cheaper cost of production. If he has not the time to give to those who are making it possible for him to achieve this result, then, in my opinion, he is a back number and a hindrance for the success of the company which employs him and the days of his usefulness are numbered.

TEXTILE EDUCATION.

The successful mill superintendent in the near future will be the product of our textile schools. The old method of learning

the business through a series of many years of practical experience fitting a man for a mill superintendent, and not giving him the position until he has reached the age of forty or fifty years, are passing. The textile training school now steps in, and offers to the young man a three years' scientific course, and when that is completed, if he will then go into the cotton mill and apply his theoretical education to the practical end of the business, say for five years more, we will then have a well equipped, wide-awake mill superintendent of say thirty years of age, full of life and energy, ready for the work, and I think that most of us would prefer for a manager the younger man thus equipped.

Industrial textile training in the cotton industry and practical experience in the mill will in the future go hand in hand, and turn out the best mill superintendents for the larger mills, as the trend of the times in cotton milling is concentration under one management of a great number of spindles, requiring well educated and practical, experienced managers. The textile schools should receive the cordial support of every one who is in any way connected with the cotton mill business, and I claim in the future they will be a great factor in the school of evolution for developing our cotton industry.

THE DAY OF SMALL THINGS IS PASSING.

Here we come to a decided change in the management of the business. There is no denying the fact that the days of small cotton mills are being rapidly numbered, and they will surely be supplanted by the mammoth mills of the future. We only have to glance backward fifty years and see how we started in New England with small mills of 2,000 to 5,000 spindles, and ask where are they to-day. You look for them and in their place stand the immense plants of Lowell, Lawrence, Fall River and New Bedford, and other towns in the states of Massachusetts, New Hampshire, Rhode Island, Connecticut and Maine.

The Southern States commenced the business in the same way

as New England, and today you hear of large mills in the South, notably,

	Capital.	Spindles.
Pelzer Mfg. Co.,	$1,000,000	120,000
Union Cotton Mills,	1,000,000	87,000
Spartan Mills,	1,000,000	75,000
Pacolet Mills,	700,000	56,000
Poe Mfg. Co.,	500,000	50,000
Clifton Mfg. Co.,	1,500,000	101,000
Olympia Cotton Mills,	1,500,000	104,000
Langley Mfg. Co.,	700,000	44,000
Gaffney Mfg. Co.,	800,000	62,000
Henrietta Mills,	700,000	72,000
Loray Mills,	1,000,000	50,000
Sibley Mfg. Co.,	900,000	43,000
John P. King Mfg. Co.,	1,000,000	60,000
Bibb Mfg. Co.,	1,800,000	67,500

Old corporations are now adding to their present capacity, doubling and trebling, all for what? To increase production and minimize cost. Competition is behind all of this, driving us to produce goods at the lowest possible figures. It is the survival of the fittest.

We hear you say at this point, Has the cotton industry been expanded beyond a healthy basis? and we answer frankly, yes, in some directions. Too many mills making the same kind of goods have been built; especially is this true of the Southern States. When a cotton mill is to be built, the projectors thereof should consider most seriously what kind of a mill to build and if the trade conditions fully warrant its construction, and if its production will command a ready sale at fair margins of profit. When sure of these very vital and essential factors for its success, then with good management and enough working capital such a mill should prove a success and not a hindrance to others in the business.

The danger has been in the South of too much competition among themselves, and rather too rapid expansion along the same lines. No one for a moment can take the position that

cotton mill expansion in the United States has reached its zenith. What we want to do for our success in the future is to expand along the right lines, and build our mills on the legitimate demands of the increase from the trade. Our natural advantages cannot be surpassed for climate and growing our own cotton.

GROWTH OF THE INDUSTRY.

We wish to call especial attention at this time to the growth of the industry, both in the New England and the Southern States, having carefully compiled the following table of statistics, which I trust will be of interest to you, and which shows the remarkable development of the cotton industry during the last fifty years:—

Fifty Years' Growth.

New England.		Southern States.	
1840,	1,597,400	1840,	180,000
1850,	1,800,000	1850,	230,000
1860,	3,859,000	1860,	298,000
1870,	5,498,300	1870,	327,000
1880,	8,632,100	1880,	1,554,000
1890,	10,836,200	1890,	3,670,800
1900,	13,750,000	1900,	5,250,000
1902,	14,000,000	1902,	6,750,000

Total for New England, Southern and Middle States, estimated 23,000,000.

When you take into consideration the capacity of the Southern mills many of them running day and night, the number of spindles do not fairly represent the output of the production, for it is safe to say that 33⅓ per cent. of the southern mills run day and night. This is especially true of the cotton yarn spinning industry. In connection with the above table I wish to call your attention to the following textlie consumption of fabrics: a complete revolution has taken place. Statistics show that in the year 1800 more flax goods were used than either wool or cotton. Flax has now dropped to the third place, the amount now consumed of flax is barely double that of 100 years ago. Wool has increased dur-

ing that time five fold and cotton has increased 39 fold, and there is today three times as much cotton goods used a woollen and seven times more than linen.

MARKETS AND TRADE TREATIES.

To expand our cotton industry and make the United States the largest producer, and get the business down to a basis where we can defy competition, there are still some very important matters necessary to be accomplished. We refer to trade treaties with foreign countries in whose markets we desire to sell our productions. Proper trade treaties should be speedily arranged with foreign countries on *a mutual basis of give and take. Remember also that if you don't buy, you cannot sell*, and if we want to sell our productions to our foreign customers, we must buy of them and let their goods, such as they want to sell us, come into our country *upon liberal concessions.*

Another important factor is transportation, our cotton manufacturers need the benefit of the lowest cost in transporting their goods to these foreign countries, and our manufacturers and merchants should make a special effort to obtain the lowest cost on transportation of their merchandise. We have much to learn yet for the requirements of our foreign customers, whose markets we are seeking to furnish with cotton goods and yarns. We must learn how they want their goods prepared, also the terms upon which they buy and trade. We must conform to their customs and not try to force our system upon them.

When we have succeeded in getting our cotton mill business down to a solid basis of competition, where we can compete with England or any other foreign country in the cost of production, and then having for our aids *proper trade treaties* with these foreign countries, besides *proper transportation facilities* and carry our goods in American vessels, then we shall see much greater expansion, and in all probability the United States will lead, in the near future, all other countries engaged in cotton manufacturing.

REPORT OF THE COMMITTEE ON FIRE TESTS OF COTTON BALES.

EDWARD W. THOMAS and WILLIAM D. HARTSHORNE.

Owing to the fact that a portion of the investigation in connection with the appraisal of the damaged cotton has not been completed at the time that this report goes to press, it becomes necessary to postpone the publication of the report and the discussion on the same until volume 74 of the Transactions. The report will be submitted in print and will be a subject of discussion at the next meeting.

INDEX.

A

Accidents in Mills, Wm. D. Hartshorne 352
Accounts, the Card System in Mill Supplies, Frank P. Vogl, 261
Active Members, Former . . . 59
Active Members, List of 13
African Market for Cotton Goods 359
Agricultural Bureau, Crop Estimates by 100
Agricultural Department, Cotton Estimates 197
Amendment to Charter 4
Amendment to Constitution, Notice of 114
American Cotton Co., Bales . . 201
American Cotton Manufacturers' Association suggested for title 114
American School of Correspondence Scholarship Offered . . . 113
American Society of Mechanical Engineers, Address by Vice-President Dodge 92
American Society of Mechanical Engineers, Meeting at 81
American Society of Mechanical Engineers, Resolution of Thanks 119
Andres, Eugene C., Grading of Egyptian Cotton 212
Associate Members, Former . . 71
Associate Members, List of . . 29
Association, Proposal to Change Name of 89
Atkinson, Edward, Estimate of Cotton Crop 188
Atkinson, Edward, Statistics Offered to 105
Attendance at New York Meeting 73
Austin, O. P., Our Foreign Commerce in Cotton Goods . . . 216
Austin, O. P., Resolution of Thanks to 119

B

Babbitt. G. H. T., Elected an Active Member 117
Bagging Invented by Nathan Burroughs 90
Ballot Committee on 117
Ballot for Membership 117
Band Pull, Wm. D. Hartshorne 147
Band Tension, Geo. Otis Draper 175
Band Tension Regulator, Wm. D. Hartshorne 166
Banding for Spindles, Observations on, Wm. D. Hartshorne 145
Barber, V. T., Elected an Active Member 117
Birch, Albert Elected an Associate Member 118
Blake, Edmund E., Elected an Associate Member 118

Bleaching and Finishing of Textile Fabrics, Arthur C. Freeman 258
Board of Government 9
Bosworth, A. E., Elected an Active Member 117
Bowen, Frank A., Grease on Shafting 142
Bremer, S. Parker, Elected an Active Member 117
British Cotton Growing Association 189
Brunton Revolving Stoker . . . 312
Burroughs, Nathan, Invention of Cotton Bagging 90
By-Laws 5
By-Laws and Constitution . . . 5

C

Cadwell, Wm. D., Sketch of . . 55
Call to New York Meeting . . . 80
Card System in Mill Supply Accounts, Frank P. Vogl 261
Cards, Adjustment of 206
Cards, Mixing for, Thos. H. Smith 208
Carelessness Generally the Cause of Seconds 349
Cary, Albert A., Mechanical Stokers 303
Census Office Estimates of Cotton Crop 199
Certificate, Trunk Line . . . 82-86
Chain Grate Stoker 311
Chanter Dumping Grate for Boilers 307
Charter 3
Chilian Market for Cotton Goods 364
Chinese Market for Cotton Goods 362
Chinese Trade 184
Classification by New York Cotton Exchange 96
Coal Strike, Carroll D. Wright . 349
Coffin, Melvin H., Elected an Associate Member 118
Coke Firing Under Boilers . . . 305
Commercial Museum, Philadelphia 365
Committee on Fire Testing of Cotton Bales, E. W. Thomas and Wm. D. Hartshorne . . . 374
Connell, John J., Length of Staple 211
Connell, John J., Preparation of Cotton for Carding and Spinning, especially Egyptian Cotton 205
Connett, Halsey, Elected an Active Member 117
Constitution and By-Laws . . . 5
Construction, Mills on the Continuous Skeleton System, Sanford E. Loring 232
Consumption of Textile Fibres . 183
Consumption and World's Supply of Cotton, S. N. D. North 182
Correspondence, American School of, Offers Scholarship . 113
Costs, Method of Keeping . . . 89
Cotton Bale, Invention of . . . 90
Cotton Bales, Fire Testing of . . 374
Cotton Bales, Weight of 90
Cotton Classification by New York Cotton Exchange . . . 96
Cotton Crop, Estimate of . . . 98
Cotton Crop for 1900 185
Cotton Exchange, Address of President 94
Cotton Gin a Factor in Local Industrialism 201
Cotton Goods, Export of, Wm. P. Wilson 357
Cotton Goods, Our Foreign Commerce in, O. P. Austin . 216
Cotton Industry, Growth of . . 372
Cotton Mill Expansion, Arnold B. Sanford 367

Cotton, Production of since 1790 186
Cotton Supply Association, Lancashire 189
Cotton, World's Supply and Consumption of, S. N. D. North 182
Cotton Yarns, Testing of, Geo. R. Smith, ... 329
Creed, P. T., Member Committee on Counting Ballots 117
Cuban Market for Cotton Goods 363
Cylinders, Double to a Frame, Thos. H. Smith 180
Cylinder Oils, Wm. F. Parish, Jr. 127

D

Daly's Differential Motion . . . 279
DeChodsko Down Draft Furnace 315
Dennett, Chas. W., Management of Mills 344
Differential Motion, Holdsworth's 273
Discipline of Help in Olden Times 348
Distribution of Members 54
Dodge, Jas. M., Address of Welcome 92
Dodge, Jas. M., Resolution of Thanks to 119
Down Draft Furnace 314
Draper, George Otis, Band Tension 175
Draper, George Otis, Moisture in Oils 136
Draper, George Otis, Power to Drive Spindles 161
Draper Loom 368
Drawing, Processes of, John J. Connell 206
Drew, O. D., Elected an Active Member 117
Drying Oils, Wm. F. Parish, Jr. 125
Duggan, Jas. B. Elected an Active Member 117
Dumping Grate for Boilers . . . 307
Dye House, Lubrication in, Wm. F. Parish, Jr. 137
Dynamo Oil, Wm. F. Parish, Jr. 130
Dynamometers, Wm. D. Hartshorne 147

E

Eastwood Down Draft Furnace 318
Edwards, Wm. Dresser, Elected an Associate Member 118
Egyptian Cotton, Grades of, John J. Connell 207
Egyptian Cotton, Grading of, Eugene C. Andres 213
Egyptian Cotton, Preparation for Carding and Spinning, John J. Connell 205
Election to Membership 117
Emerson Power Scale, Wm. D. Hartshorne 147
Ericsson, Capt. Thos., Portrait of 94
Estimate of Cotton Crop 98
Estimates of Cotton Crop . . . 194
Expansion of Cotton Mills, Arnold B. Sanford 367
Exports of Cotton, Early 90
Export of Cotton Goods, Wm. P. Wilson 357

F

Fairbain Down Draft Furnace . 317
Fales & Jenks Spindles 176
Fine Frames, John J. Connell . . 207
Fire Testing of Cotton Bales, Committee on, E. W. Thomas and Wm. D. Hartshorne . . . 374
Fire Tests of Cotton Bales . . . 91
Fish, Chas. H., Accident in Mills 353
Fish, Chas. H., Oil for Looms . 142
Fish, Chas. H., President's Address 87
Fleming, L. L., Address of Welcome 108
Foreign Commerce, O. P. Austin 216
Foreign Market for Cotton Goods 360
Former Members of the Association 59

Fossell, Joseph, Elected an Associate Member 118
Foster, M. F., Member of Committee on Resolutions 115
Frames, Tension on, Wm. E. Winchester 269
Free Hospital for Help 350
Freeman, A. C., Bleaching and Finishing of Textile Fabrics . 258
Friction of Lubricants, Wm. F. Parish, Jr. 122
Friction Machines, Wm. F. Parish, Jr. 123
Friction, Work of, R. H. Thurston 167
Fries, John W., Mill Construction 257
Fries, John W., On Sizing Compounds 260
Frisbie Underfed Stoker 321
Fulton, Robert, Portrait of . . . 94

G

Grading of Egyptian Cotton, Eugene C. Andres 213
Gratz, Simon 90
Gratz, Simon, Invention of Standard Cotton Bale 90
Grease of Shafting 142
Geographical Arrangement of Members 36
Georgia Cotton Growers' Protective Association, Resolutions on Estimating Cotton Crop . 198
Government, Board of 9
Growth of Cotton Industry . . . 372
Guion, Louis I., Elected an Active Member 117
Gulliver, Arthur H., Mill Construction 253
Gwathmey, J. Temple, President of the New York Cotton Exchange, Address of 94
Gwathmey, J. Temple, Resolution of Thanks to 119

H

Hartshorne, Wm. D., Accidents in Mills 352
Hartshorne, Wm. D., Committee on Fire Testing of Cotton Bales 374
Hartshorne, Wm. D., Observations on Spindle Banding . . 145
Hartshorne, Wm. D., Committee on Standard Accounts 116
Heavy Machinery, Lubrication of, Wm. F. Parish, Jr. 131
Help, Management of 345
Hastings, Walter Maxwell, Elected an Associate Member 119
Holdsworth's Differential Motion 273
Honorary Members, Former . . 59
Honorary Members, List of . . 13
Hook Band, Wm. D. Hartshorne 163
Hotels in New York 82
Hubbard, Samuel T., Address of Welcome 96
Humidity of Air Affecting Power in Spinning Room 161

I

Imports of Cotton Goods, O. P. Austin 220
In Memoriam 55
Intermediate, John J. Connell . 206

J

Jamieson, Joseph B., Elected an Active Member 118
Johnson, J. B., Tests of Timber 245
Jones, Evan William, Inventor of Underfeed Stoker 285
Jukes Chain Grate Stoker . . . 311

K

Kidder, F. E., Tests of Timber . 247

L

Lacey, Fred, Member of Committee on Counting Ballots . . 117

Laps, Weight of . . . . . 205—208
Lancashire Cotton Supply Association 189
Lancashire Textile Manufacturers' Association 368
Leigh Coal Hopper for Boilers . 307
Light Machinery, Lubrication of, Wm. F. Parish, Jr. 131
Liverpool, Maury First Consul at 104
Looms, Lubrication of, Wm. F. Parish, Jr. 133
Loring, Sanford E., Lighting of Mills 351
Loring, Sanford E., Mill Construction on the Continuous Skeleton System 232
Lowry Bales 201
Lubricant, Wear of, C. J. H. Woodbury 179
Lubrication of Textile Mills, Wm. F. Parish, Jr. 122

M

Management of Mills, Chas. W. Dennett 344
Manager, Duties of 346
Manchester Cotton Growers' Association 189
Manufacturing Accounts, Committee on 115
Manufacturing Accounts, Committee on Standard Form of . 116
Marshall Spinning Frame . . . 369
Mason, Arthur H., Elected an Active Member 118
Maury, Jas. F., Address of Welcome 98
McDonald, Albert E., Elected an Active Member 118
McDuffie, Charles D., Sketch of 56
McLane, Jas. A., Elected an Active Member 118
Mechanical Engineers, American Society of, Resolution of Thanks 119
Mechanical Stokers, Albert A. Cary 303
Members of the Association, List of 13
Members Elected 117
Membership, Alphabetical List of 13
Membership, Geographical Arrangement of 36
Merriam, Joseph, Elected an Active Member 118
Mill Agent and Engineer 87
Mill Construction on the Continuous Skeleton System, Sanford E. Loring 232
Mill Supply Accounts, Card System in, Frank P. Vogl 261
Miller, R. M., Jr., Member of Committee on Resolutions . . 115
Miller, Walter T., Address of Welcome 102
Mills, Jas. K., Method of Purchasing Cotton 102
Mills, Management of, Chas. W. Dennett 344
Mixing Cotton 205
Montgomery, J. R., Chairman of Committee on Resolutions . . 115
Mulhall, Estimates of Value of Cotton Goods 222

N

Name of the Association, Notice of Change 114
Name of Association, Proposal to Change 89
New York Cotton Exchange, Address by President Gwathmey 94
New York Cotton Exchange, Invitation of 85

New York Meeting, Attendance at 73
New York Meeting, Call to . . . 80
Night Running of Southern Mills 372
North, S. N. D., Resolution of Thanks to 119
North, S. N. D., Word's Supply and Consumption of Cotton . 182
Northrop Loom 368
Number of Members . . . . 35—54

O

Observations on Spindle Banding, Wm. D. Hartshorne . . 145
Officers of the Association . . . 10
Oils, Chemistry of, Wm. F. Parish, Jr. 124
Oils, Moisture in 138
Oklahoma Cotton Crop 188
Our Foreign Commerce in Cotton Goods, O. P. Austin . . . 216

P

Paraffine on Warps, A. C. Freeman 259
Parish, Wm. F., Jr., Lubrication of Textile Mills 122
Past Members of the Association 59
Philadelphia Commercial Museum 365
Photograph of Meeting 355
Plank Mill Construction 232
Power to Drive Spindles, Geo. Otis Draper 161
Power Scale, Wm. D. Hartshorne 147
Presents for Help 350
Preparation of Cotton for Carding and Spinning, especially Egyptian Cotton, John J. Connell . 205
President's Address 87
Prest, John E., on Differential Motions 282
Prest, John E., Length of Staple 210
Prest, John E., Mill Construction 254
Prest, John E., Multiple Band for Spindles 178
Prest, John E., Oil for Rabbeth Spindles 139
Prest, John E., Weight of Laps on Cards 208
Price, Theodore H., Elected an Associate Member 119
Proceedings 73
Production of Cotton Since 1790 186
Programme 84

R

Rabbeth Spindle, Oil for, John E. Prest 139
Reclamation on Cotton 106
Resolution of Thanks 119
Resolutions, Committee on . . 115
Revolving Grate Stoker . . . 312
Rodda Down-Draft Furnace . . 314
Rotary Ring Frame 369
Roundlap Bales 201
Roving Frames, Tension on, Wm. E. Winchester . . . 269
Russian Encouragement of Cotton Growing 189

S

Sanford, Arnold B., Cotton Mill Expansion 367
Sanford, Arnold B., Mill Construction 250
Sanford, Pardon B., Elected an Active Member 118
Sawyer's Spindle, Lubrication of, Wm. F. Parish, Jr. 136
Shafting, Lubrication of, Wm. F. Parish, Jr. 132
Shoddy, Legislation on 183
Sizing Compounds, John W. Fries 260
Skeleton System of Mill Construction, Sanford E. Loring 232
Slubbing, John J. Connell . . 206
Smith, Geo. R., Resolution of Thanks to 119

Smith, Geo. R., Testing of Cotton Yarns 329
Smith, Thos. H., Absorption of Water by Oil 139
Smith, Thos. H., Double Cylinders to a Frame 180
Smith, Thos. H., Mixing for Cards 208
Smith, Thomas H., Staple, Length of 208
Smith, Underfed Stoker 325
Smoke Reducing Furnace, Jas. Watt 313
Southern Cotton Crop for Many Years 186
Southern Cotton Mills 371
Speeds, Increase of 369
Spindle Banding, Observations on, Wm. D. Hartshorne . . . 145
Spindle Lubrication, Wm. F. Parish, Jr., ... 134
Spinning, Preparation of Cotton for, John J. Connell 205
Stainless Oil, William F. Parish, Jr. 133
Standard Cotton Bale, Invention of 90
Staple, Length of, Thos. H. Smith 208
Statistics Offered to Edw. Atkinson 105
Stokers, Mechanical, Albert A. Cary 303
Stokers, Underfeed, George C. Tewksbury 285

T

Tape Bands for Spindles, Wm. D. Hartshorne 163
Temperature Changing Friction, Wm. D. Harthorne 157
Tension on Roving Frames, Wm. E. Winchester 269
Testing of Cotton Yarns, Geo. R. Smith 329
Tewksbury, Geo. C., Underfeed Stoker 285
Texas Cotton Crop 187
Textile Education 369
Textile Fibres, Consumption of . 183
Thanks, Resolutions of 119
Thomas, Edw. W., Committee on Fire Testing of Cotton Bales 374
Tobey, R. Irving, Elected an Active Member 118
Toohey, M. J., Elected an Active Member 118
Top Rolls, Lubrication of, Wm. F. Parish, Jr. 136
Trunk Line 86
Trunk Line Certificates 82
Turnbull, Arthur, Elected an Associate Member 119
Tweedale's Differential Motion . 273

U

Under-Feed Stoker, Geo. C. Tewksbury 285

V

Viscosity of Oils, Wm. F. Parish, Jr. 140
Vogl, Frank P., Card System in Mill Supply Accounts 261

W

Watt, Jas., Smoke Reducing Furnace 313
Weeks, Geo. W., Sketch of . . . 57
Weighted Band 169
Weighted Tape Bands, Wm. D. Hartshorne 163
West Indian Market for Cotton Goods 363

Wilbur, E. B., Donation of Cotton Bolls 96
Wilson, Dr. Wm. P., Export of Cotton Goods 357
Wilson, Dr. Wm. P., Resolution of Thanks to 119
Winchester, Wm. E., Tension on Roving Frames 269
Wood Burning Boiler Furnaces . 319
Wool, Consumption of 229
World's Supply and Consumption of Cotton, S. N. D. North . . 182
Worthington, Henry R., as an Engineer 88
Worthington Underfed Stoker . 325
Woodbury, C. J. H., Wear of Lubricants 179
Wright, Carroll D., On Coal Strike 349

Y

Yarns, Testing of Cotton, Geo. R. Smith 329

HOWARD & BULLOUGH

American Machine Co. Ltd.

PAWTUCKET, R. I.

BOSTON OFFICE—281 Congress St.
SOUTHERN OFFICE—814-815 Empire Bldg., Atlanta, Ga.

COTTON MACHINERY

We Invite Your Investigation and Comparison.

Bale Breakers
Hopper Bale Openers
Feeders
Self Feeding Openers
Breaker, Intermediate and Finisher Lappers.

Revolving Flat Cards
Drawing Frames
Slubbing, Intermediate and Roving Frames.

Improved New Pattern Spinning Frames
Twisters for Wet or Dry Work
Cone Winders.

Warpers and Slashers.

Send for Descriptive Circulars with lists of users.

THE NAME OF

"KITSON"

Has for more than Fifty Years stood for all that is Best in

Picker Construction.

Our Works are Devoted Exclusively to the Manufacture of

Picker Room Machinery

For Preparing Cotton and Waste for Carding.

Kitson Machine Co.

Lowell, Mass.

STUART W. CRAMER, Southern Agent, Charlotte, N. C. and Atlanta, Ga.

Stoddard, Haserick, Richards & Co.

BOSTON, MASS. AND BRADFORD, ENGLAND.

Bankers and Importers.

Sole Representatives for

DOBSON & BARLOW, Ltd., - - - Bolton.

Improved Bi-Simplex Carding Engines, with Patent Anti-Flexion Grinder.
Heilman Combs, Single and Duplex.
Ribbon Lap Machines. Sliver Lap Machines.
Slubbers, Intermediates, Rovers and Jacks.
Improved Self-Acting Mules for Cotton.
Gassing Frames and Winders.
SPECIAL Opening and Picking Machinery for Delicate Cottons.
SPECIAL attention given to Medium and Fine Counts.
WORSTED CARDING ENGINES.
WORSTED MULES.

SAMUEL LAW & SONS, Ltd., - - Cleckheaton.

CARD CLOTHING OF ALL DESCRIPTIONS.

TAYLOR, WORDSWORTH & CO., - - Leeds.

NOBLE COMBS and BACKWASHERS.

PRINCE SMITH & SON, - - - - Keighley.

WORSTED DRAWING and SPINNING MACHINERY.
BRADFORD SYSTEM and CONE SYSTEM.

Société Alsacienne de Constructions Mécaniques, Mulhouse.

WORSTED DRAWING on FRENCH SYSTEM.
GEGAUFF COTTON COMBER.

EGYPTIAN COTTON

FROM

CARVER BROS. & CO., Ltd., Alexandria and Liverpool.

The American Mfg. Co.

65 WALL ST., NEW YORK.

MANILA—SISAL—JUTE

CORDAGE.

"AMERICAN" TRANSMISSION ROPE.

SELF LUBRICATING.

A little Blue Book on Rope Transmission sent free upon request.

OUR JUTE ROPE—STAINLESS

Is the best and most economical cordage for BALING TEXTILE FABRICS.

FOR a Fly Frame that will give you a large production at small amount of cost and horse power, go to the WOONSOCKET MACHINE & PRESS COMPANY, Woonsocket, R. I. They also manufacture Cloth Trimmers, Shafting, Hangers, Pulleys, Friction Clutches, &c.

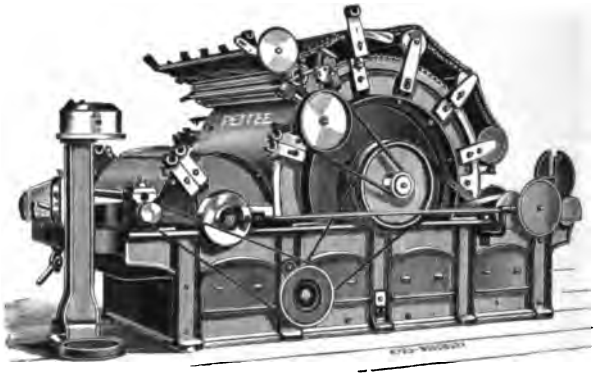
Saco AND Pettee Machine Shops

Main Office, NEWTON UPPER FALLS, MASS.

COTTON MACHINERY

OF THE

LATEST IMPROVED PATTERN.

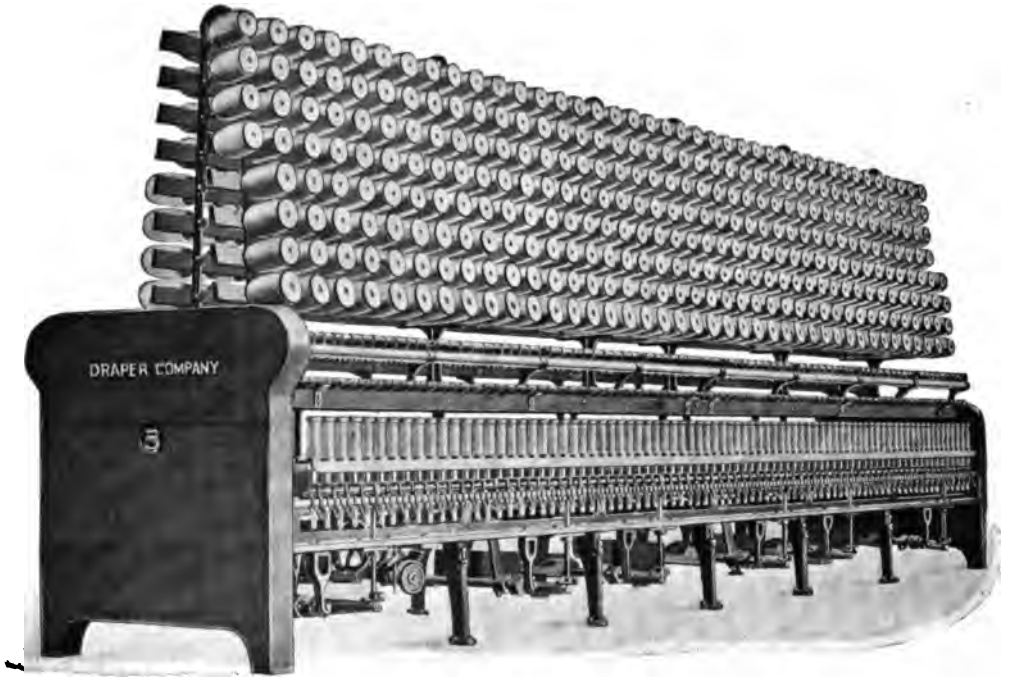


Picking Machinery,
Revolving Flat Cards,
Railway Heads,
Drawing Frames,
Slubbing,
Intermediate,
Roving and
Spinning Frames.

SHOPS: . . . { **Biddeford, Maine.** / **Newton Upper Falls, Mass.**

☞Send for estimates and prices.

73—74 T. F.



Our New Twister.

Made Throughout from New Patterns.

Extra Weight,
Draper Twister Spindles.

Adjustable Legs,
New Patented Details.

BUILT FOR SPEED.

The demand for our Twisters steadily increases. We also build Northrop Looms, Warpers, Spoolers, Reels, Banding Machines, Spindles, Temples, Round Spinning Rings, Separators, etc.

THE DRAPER CO., HOPEDALE, MASS.

ELIJAH ASHWORTH,

Manufacturer of Card Clothing.

Bright Hardened and Tempered Steel Wire, Plough Ground or Surface Ground

CLOTHING FOR REVOLVING FLAT CARDS A SPECIALTY.

All makes of Top Flats Reclothed by Ashworth's Patent Steel Clamp Fastening.

ESTIMATES PROMPTLY GIVEN.

HENRY ASHWORTH, Agent, Fall River, Mass.

73—74 T. F.

General Fire Extinguisher Co.

Manufacturers, Jobbers, and Dealers in PIPE, FITTINGS, VALVES, HYDRANTS, and all kinds of Steam, Gas and Water Supplies and Specialties.

Factories and Warehouses equipped with the GRINNELL AUTOMATIC SPRINKLER, on the wet pipe or dry pipe system, as may be desired.

The Grinnell Dry Pipe System affords thorough protection all the year around for buildings in which the water in a wet pipe system would freeze.

Information and proposals furnished at the Several Department Agencies, and at the

Executive Offices, PROVIDENCE, R. I.

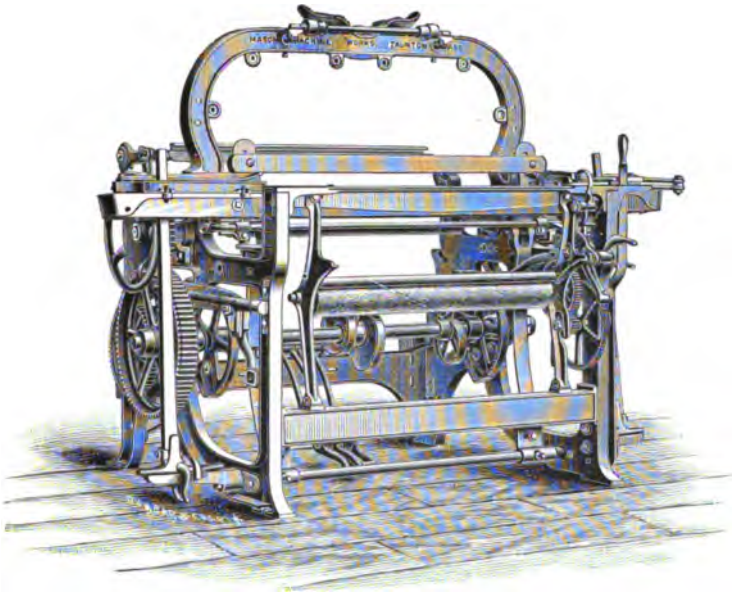
73—74

MASON MACHINE WORKS,

TAUNTON, MASS.

—— BUILDERS OF ——

COTTON MILL MACHINERY.



REVOLVING FLAT CARDS,
COMBING MACHINERY,
DRAWING FRAMES,
SPINNING FRAMES,
MULES AND LOOMS.

Southern Office Address:

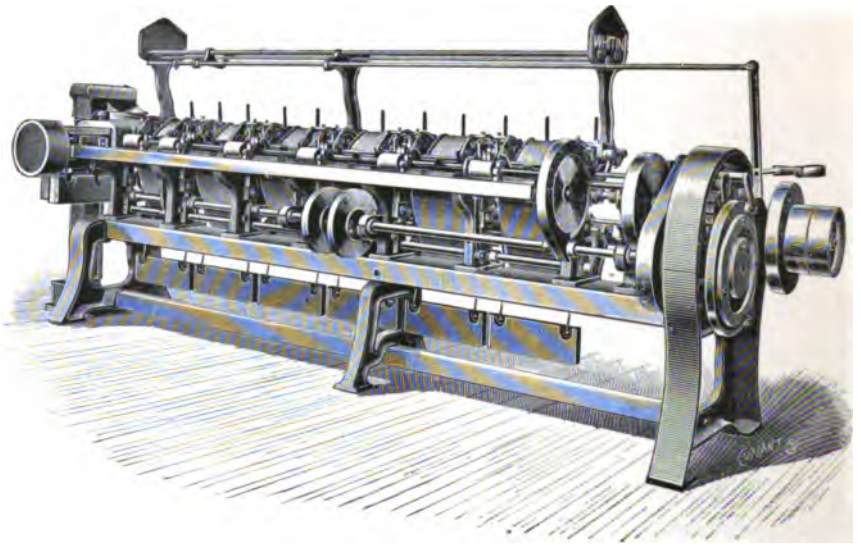
MASON MACHINE WORKS,
CHARLOTTE, N. C.

The Whitin Machine Works,

WHITINSVILLE, MASS.

BUILDERS OF

COTTON MACHINERY



WHITIN COMBER.

Cards,	**Railway Heads,**	**Long Chain Quillers,**
Sliver Lap Machines,	**Drawing Frames,**	**Reels,**
Ribbon Lap Machines,	**Spinning Frames,**	**Twisters,**
Combing Machines,	**Spoolers,**	**Looms.**

SOUTHERN AGENT:

STUART W. CRAMER, - - Charlotte, N. C.

AND EQUITABLE BUILDING, ATLANTA, GA.

H. G. McKERROW & CO.,

TEXTILE MACHINERY,

31 State St., BOSTON, MASS.

AMERICAN AGENTS FOR

TWEEDALES & SMALLEY, - - - CASTLETON, ENGLAND.
Cards, Drawing Frames, Slubbing, Intermediate and Roving Frames.

TAYLOR, LANG & CO., - - - - - STALYBRIDGE, ENGLAND.
Self Acting Mules for Fine, Medium and Coarse Counts.

Messrs. WILLIAM RYDER, - - - - - - BOLTON, ENGLAND.
Spindles and Flyers.

t. f. 73 **Card Clothing, and other Textile Sundries.**

MONFORT'S COMBING MACHINES

For Combing Staples from 7/8 inch to Sea Island Cotton.

Production from 350 to 650 lbs. per week, according to staple.

Schwartz & McKerrow, = Sole Agents,

t. f. 73 **31 STATE ST., BOSTON, Room 908.**

Rice & Sargent and Improved Greene Engines

For Mills, Electric Plants, and All Power Purposes.

Especially adapted to Textile Plants where the extreme delicacy of engine regulation allows the machinery to be run at its maximum speed.

PROVIDENCE ENGINEERING WORKS,

SOLE BUILDERS. **PROVIDENCE, R. I.**

73

THE METALLIC DRAWING ROLL CO.

SOLE MANUFACTURERS OF

PATENT METALLIC ROLLS

FOR FIBROUS MATERIALS.

This system gives the most satisfactory results. No licking up of leather rolls caused by electricity and sticky weather. 25 to 33 per cent. more production guaranteed than can be received from any leather roll, rolls being same diameter and running same speed. Also superior yarn, less waste and at greatly reduced cost.

ALL WORK GUARANTEED.

Write for Prices and Particulars to

THE METALLIC DRAWING ROLL CO.,

72—73 **INDIAN ORCHARD, MASS.**

Power Transmission Machinery.

Patent Process Turned Shafting.

New Modern Self Oiling Bearings.

Hunter's Hub Friction Couplings and Pulleys.

Hunter's Rim Friction Couplings and Pulleys.

Hunter's Disc Friction Couplings and Pulleys.

Cotton Dryers.

The Stone Dryer for Cotton, Wool and Rags.

Jas. Hunter Machine Co.,

Boston Sales Office,
70 Kilby St., Mason Building.

NORTH ADAMS, MASS.

72—73

TALK

May go in one ear and out the other, but our record of

30 YEARS OF SUCCESS

in Ring Making, and 30 years of Constant Growth, must find a lodgement in the minds of Mill Men and convince them of the superiority of our Rings.

Our U. S. S. Traveler Cleaner is perfection itself.

Our Patent Traveler Cup is a great traveler saver.

Whitinsville Spinning Ring Co.,

WHITINSVILLE, MASS.

72—73

THE J. R. MONTGOMERY CO.

WINDSOR LOCKS, CONN.

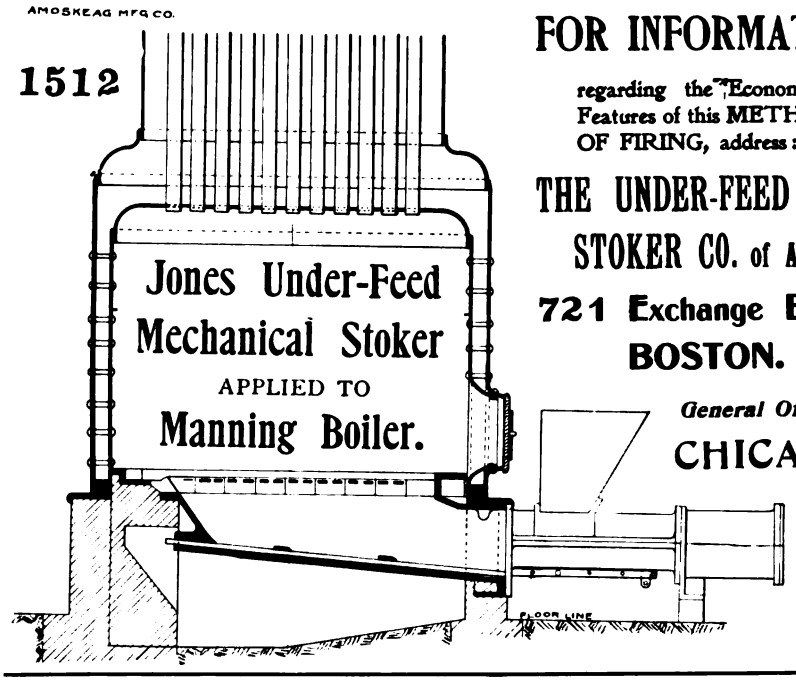
MERCERIZED COTTON YARNS

Showing Highest Possible Silk Lustre.

High Grade Cotton Warps AND Novelty Yarns.

Printers of Cotton, Wool, and Worsted Yarns.

72—73



FOR INFORMATION

regarding the Economical Features of this METHOD OF FIRING, address:

THE UNDER-FEED STOKER CO. of America.

721 Exchange Bldg., BOSTON.

General Offices:

CHICAGO.

72—73

One Results from Use of the Other.

CLEAN SWEET MILL FLOORS.

SAVOGRAN.

INDIA ALKALI WORKS, 28-37 India Wharf, Boston.

Highest Awards, 1893–1887–1878. "27 years at it."

72—73

TELEPHONE, MAIN NO. 2206.

72—73

Charles River Iron Works.

EDWARD KENDALL & SONS,

MANUFACTURERS OF

HORIZONTAL AND UPRIGHT

STEAM BOILERS

And Plate Iron Work of Every Description.

HIGH PRESSURE BOILER PLANTS FOR COTTON MILLS OUR SPECIALTY.

END OF WEST BOSTON BRIDGE,

ESTABLISHED 1860. **CAMBRIDGEPORT, MASS.**

71—73

6000 Barber Knotters

NOW IN USE.

Endorsed by Over 400 Cotton Mills.

BARBER & COLMAN,

11 Pemberton Square,

ROBERT C. WEBSTER, *Manager.* **BOSTON, MASS.**

72—73

LUXFER PRISMS

SAVE MONEY

by reducing the cost of Artificial Light.

LUXFER SHEET PRISMS cost little more than ordinary glass. They give **FIFTY TIMES MORE LIGHT.**

WRITE FOR CIRCULARS, OR TELEPHONE MAIN, 1071.

AMERICAN LUXFER PRISM CO.

15 FEDERAL STREET,

MARSH & BRADLEY, N. E. AGENTS. **BOSTON, MASS.**

72—73

NEW BEDFORD

Textile School

America's Model Textile School.

New Bedford, Mass.

Founded by the Commonwealth of Massachusetts and the City of New Bedford.

Equipped with standard mill machinery of the best American and English makes.

Instruction in Picking, Carding, Spinning, Weaving, Designing, Knitting, Chemistry, Dyeing, Mill Engineering, Etc.

Free Catalogue sent on application to

C. P. Brooks,

Managing Director.

GOLD MEDAL Paris Exposition 1900.

72—73

THE PHILADELPHIA

COMMERCIAL MUSEUM.

Dr. William P. Wilson, Director.

Supplies Detailed, Specific Information concerning the Trade Conditions of the World's Markets.

It tells Where The Markets Are and by whom supplied.

Who the Responsible Buyers Are and How to Reach Them.

It can ascertain for you the particular Requirements of any or all markets in The Line of Goods You Make.

It has inaugurated a most valuable method of Registering American Manufacturers in Foreign Countries by means of **Card Index Files** placed in the Chambers of Commerce in Forty-five of the Principal Commercial Centers of the World.

This is a movement in the interest of American Commerce with which You Should Be Identified. Write for particulars to

The Philadelphia Commercial Museum,

233 So. Fourth St., Philadelphia, Pa.

73

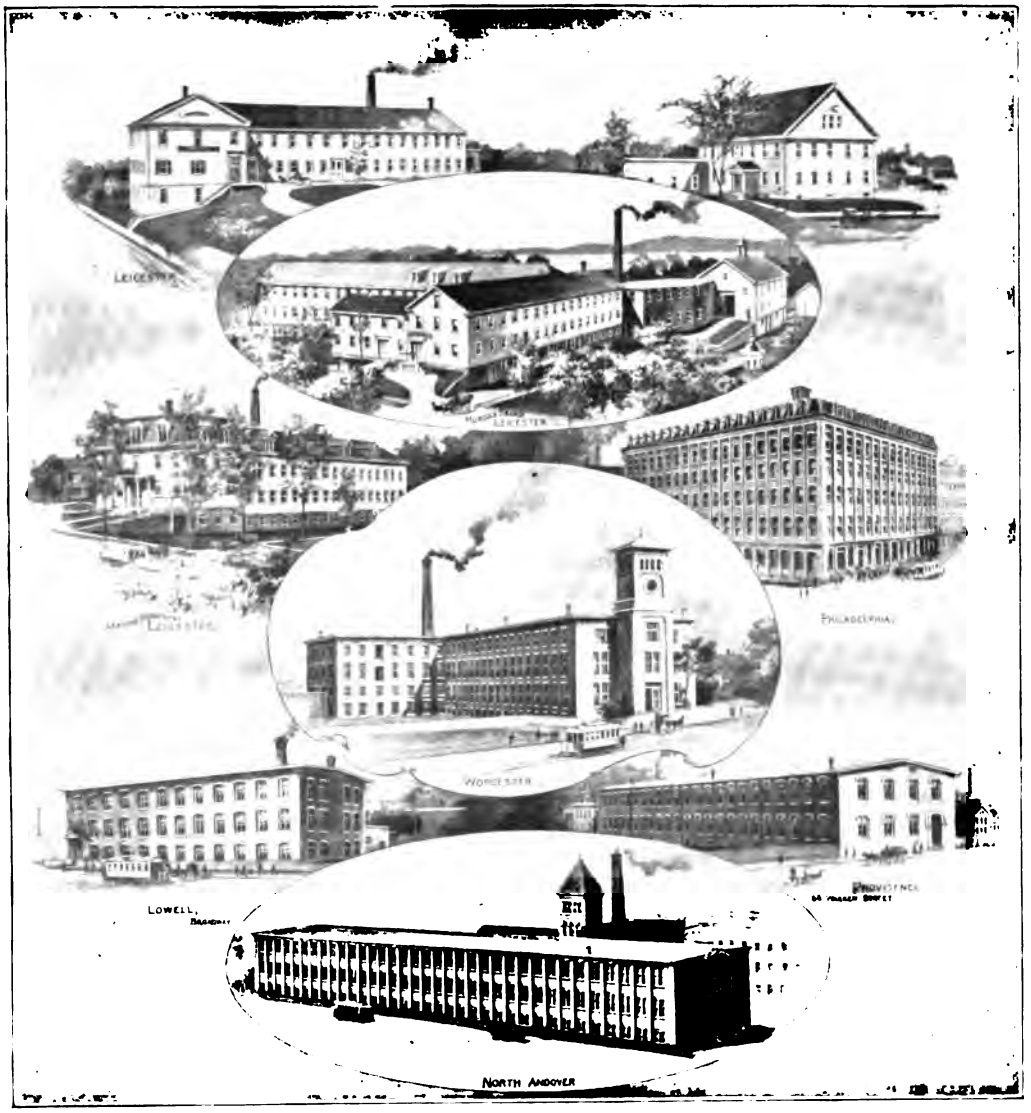
INCORPORATED JUNE 4, 1890.

American Card Clothing Co.

GENERAL OFFICES: Worcester, Mass.

SEND ORDERS TO FACTORIES:

Worcester, Mass. **Leicester, Mass.** **North Andover, Mass.**
Lowell, Mass. **Philadelphia, Pa.** **Providence, R. I.**



Manufacturers of Every Description of CARD CLOTHING.

Special Attention given to Clothing for Revolving Top Cards. Experts Furnished to Clothe and Start the same.

Hardened and Tempered Steel Wire Card Clothing. Plough Ground or Surface Ground. Revolving Top Flats covered and clothing fastened with Steel Clips.

Southern Agency, Charlotte, N. C.

The Cohoes Iron Foundry & Machine Co.

COHOES, NEW YORK.

——MANUFACTURERS OF——

The Cohoes Slasher.

Size Tanks, Tramways and Special Machines.

Correspondence Solicited.
73—74 T. F.

Practical Cotton Calculations

BY

ERNEST WHITWORTH.

PRICE
$1.00

This Book has been highly recommended by Cotton Mill

AGENTS
OVERSEERS
TREASURERS
SUPERINTENDENTS
TEXTILE PAPERS
TEXTILE SCHOOL INSTRUCTORS
AND MEMBERS OF THE N. E. C. M. A.

Sample Pages and Index sent on application to

ERNEST WHITWORTH, Box 285, Globe Village, Mass.

73—74

Inspection. Protection.

J. M. ALLEN, President,

W. B. FRANKLIN, Vice-President,

F. B. ALLEN, 2d Vice-President,

J. B. PIERCE, Sec'y and Treas.

Northeastern Department,

C. E. ROBERTS, - - - Manager.

125 MILK STREET,

BOSTON.

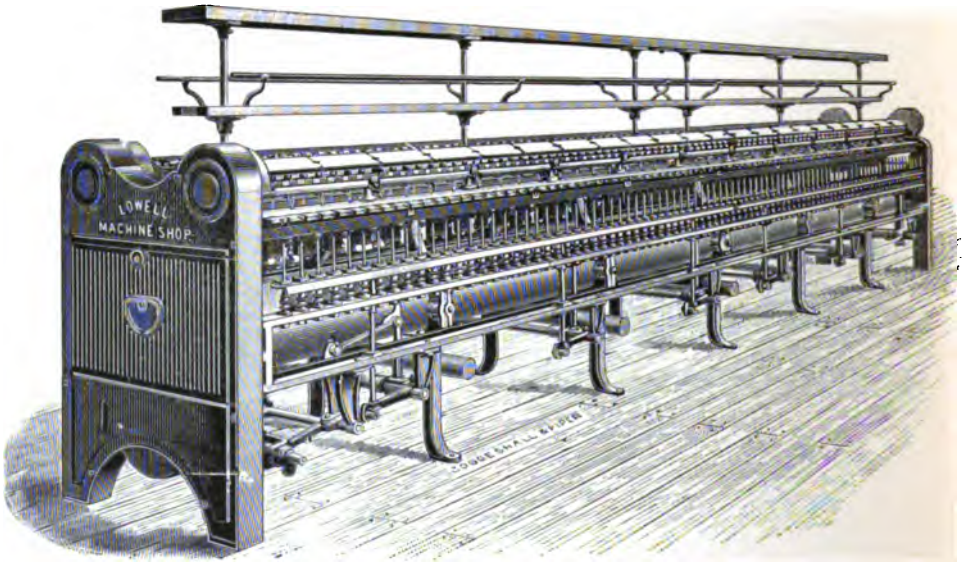
LOWELL MACHINE SHOP,

LOWELL, MASS.,

Builders of

Cotton Machinery

Of Every Description.



Revolving Flat Cards,
Railway Heads,
Ring Spinning Frames,
Drawing Frames, **Fly Frames,**
Spoolers, Warpers,
Slashers, Looms.

WORSTED MACHINERY.

Illustrated Catalogues sent on Application.

GENERAL ELECTRIC CO.

installs

Electric Power and Lighting Plants

for all classes of

TEXTILE MILLS.

45,000 HORSE POWER IN USE OR UNDER CONTRACT.

THE ADVANTAGES OF ELECTRIC DRIVE ARE:

Saving in the cost of building, shafting and belting and of investment for future extension.

Increased production and fewer "seconds" due to absolute uniformity in speed.

More product per horse power at the engine.

Subdivision of power — independent operation of each department.

Among other Mills equipped with Electric Drive in whole or in part by the General Electric Company, are:

LANCASTER MILLS, Clinton, Mass.
PELZER MILLS, Pelzer, South Carolina.
SOULE MILLS, New Bedford, Mass.
LUDLOW MFG. CO., Ludlow, Mass.
OLYMPIA MILLS, Columbia, S. C.
AMERICAN WOOLEN CO., Lawrence, Mass.
AMERICAN WOOLEN CO., Maynard, Mass.
AMOSKEAG MILLS, Manchester, N. H.
AMERICAN THREAD CO., Holyoke, Mass.
STEVENS MANUFACTURING CO., Fall River, Mass.
ONEITA KNITTING MILLS, Utica, N. Y.

The General Electric Company employ specialists trained in textile work, whose services are at disposal of engineers or manufacturers for consultation or advice.

The General Electric Company

General Office, Schenectady, N. Y.

New York Office, 44 Broad St. Boston Office, 200 Summer St.

Philadelphia Office, 204 South Eleventh St. Atlanta Office, Empire Building.

LONDON OFFICE, 83 CANNON STREET, E. C.

WILLIAM FIRTH, President. EDWIN BARNES, Vice-President. JOHN H. NELSON, Treasurer.

WILLIAM FIRTH COMPANY,

67 Equitable Building, 150 Devonshire St., Boston, Mass.

SOLE IMPORTERS OF

ASA LEES & CO., LIMITED. TEXTILE MACHINERY.

Including, Bale Breakers, Revolving Flat Cards for Cotton, Drawing Frames, Slubbing Frames, Intermediate Frames, Roving Frames, Combers, Ribbon and Comber Lap Machines, Carding Engines for wool, wadding, and also Condensers, &c. New Patent Self-Acting Mules for cotton and worsted yarns.

SOLE AGENTS FOR

William Tatham & Co., Waste Machinery.

Joseph Stubbs, Gassing, Winding and Reeling Machinery for Cotton, Worsted and Silk.

George Hattersley & Sons, Limited, Makers of every description of Looms, &c.

James Mackie & Sons, Limited, Makers of Flax, Tow, Hemp and Jute Preparing and Spinning Machinery.

George Orme & Co.'s Patent Hank Indicators, &c.

James Yates & Son Hardened and Tempered Steel Card Clothing for Woolen and Worsted Cards.

Lockett, Crossland & Co., Engravers and Builders of Leather Embossing Machinery, &c., &c.

SELLING AGENTS FOR

Joseph Sykes Bros., Hardened and Tempered Steel Card Clothing for Cotton.

Dronsfield Bros., Limited, Emery Wheel Grinders, Emery Fillet and Flat Grinding Machines.

YARN TESTING MACHINERY, WRAP REELS, HEDDLES,
73—74 COMBER PINS, PICK GLASSES, &c.

PHILADELPHIA
TEXTILE SCHOOL.

[PENNSYLVANIA MUSEUM AND SCHOOL OF INDUSTRIAL ART.]

TWENTIETH YEAR.

Instruction Given in All Branches of the Manufacture of Cotton, Wool, Worsted and Silk.

Complete Modern Equipment for Carding, Spinning, Dyeing, Weaving and Finishing.

1903—Day Classes open September 28, Evening Classes open October 5.

Endorsed by leading manufacturers and educators. Send for Illustrated Year Book.

EDWARD W. FRANCE, Director.
Broad and Pine Sts., Philadelphia.

ROUNDLAP BALE UNROLLING MACHINE, BOSCA & BENNER TYPE.

The American Cotton Company's Roundlap Bale is used in every part of the spinning world.

Spinners prefer Roundlap cotton for the reason that it is cleaner and produces more yarn than cotton put up in American square bales.

Cotton Bale Fire Tests held at Chester, Pa., August 5, 1902, by the National Fire Protection Association demonstrated not only that the Roundlap Bale is superior as an insurance risk to all other cotton packages, but that it is a more desirable risk than baled cotton goods.

The Tests showed that, besides eliminating the flash hazard that causes three-fourths of all cotton fires in the United States from reported causes, the Roundlap yields greater salvage than any other cotton bale.

The American Cotton Company,

General Offices, 25 BROAD ST., NEW YORK.

E. C. ANDRES. F. H. ANDRES.

Fr. Jac. Andres,

JOHN HANCOCK BUILDING, - BOSTON, MASS.

Egyptian and Rough Peruvian Cotton.

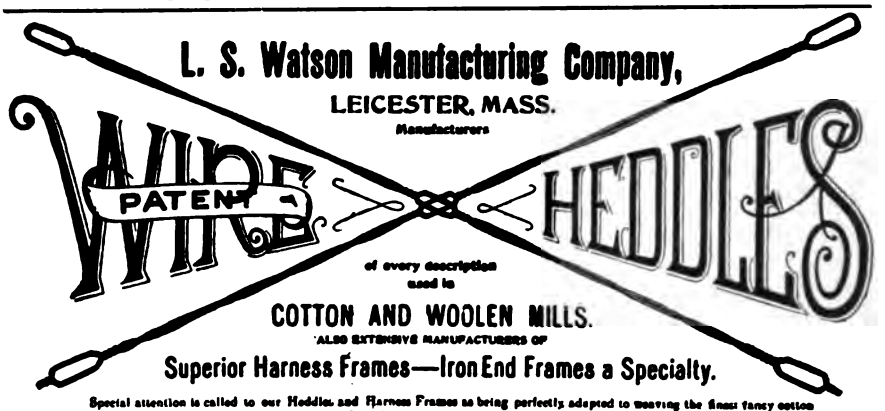
(My Specialty since 1868.)

73—74 EXPORTERS AND IMPORTERS.

L. S. Watson Manufacturing Company,

LEICESTER, MASS.

Manufacturers



of every description used in

COTTON AND WOOLEN MILLS.

ALSO EXTENSIVE MANUFACTURERS OF

Superior Harness Frames—Iron End Frames a Specialty.

Special attention is called to our Heddles and Harness Frames as being perfectly adapted to weaving the finest fancy cotton goods. We are also *AGENTS and IMPORTERS of the German Tinned Cast Steel Wire Heddles.*

These Heddles are made with soldered warp eyes, also soldered end eyes, and are the most DESIRABLE FOREIGN HEDDLE MADE

Correspondence and Orders solicited. Write us for Samples and Prices.

73—74

American Cotton Yarn Exchange,

Combed and Carded Cotton Yarns

From Northern and Southern Mills.

American, Egyptian, Peruvian and Sea Islands.

ARNOLD B. SANFORD, PRES. AND GEN. MGR.

NO. 67 CHAUNCY ST., BOSTON, MASS.

Long Distance Phone, No. 1120 Oxford.

73—74

The Green Fuel Economizer Company

OF MATTEAWAN, N. Y.

H. G. BRINCKERHOFF, New England Manager.

GREEN'S ECONOMIZER, Already applied to Three Hundred Thousand Steam Boilers.

53 STATE ST., BOSTON, Telephone, Main 1653.

73—74

HOWARD BROS. M'F'G. CO.

44 and 46 Vine Street, Worcester, Mass.

——MANUFACTURERS OF——

CARD CLOTHING,

Stripping Cards and Wire Heddles.

Also Manufacturers of the so-called German Tinned Cast Steel Wire Heddles.

OUTSIDE OF THE CARD CLOTHING COMBINE.

73—74

F. P. SHELDON,

MILL
STEAM
HYDRAULIC
ELECTRICAL
} ENGINEER.

INDUSTRIAL TRUST BUILDING,
PROVIDENCE, R. I.

Dinsmore Manufacturing Co.

(ESTABLISHED 1874.)

SALEM, - - MASS.

Mill Sewing Machines

AND SUPPLIES.

13 Different Styles of Machines

For Cotton and Woolen Mills, Bleacheries, Print Works, Silk Mills, &c.

Over 2500 in Use.

CHAS. F. CURWEN, *Treasurer.*

Send for Illustrated Catalogue.

73—74

SALEM ELEVATOR WORKS,

CHAS. F. CURWEN, Proprietor,

SALEM, - MASS.

ELEVATORS.

ELECTRIC, BELT AND HAND POWER.

AUTOMATIC HATCH DOORS,

SELF-CLOSING SAFETY GATES.

Send for Illustrated Catalogue.

73—74

HOLYOKE MACHINE CO.,

Worcester, Mass.

Hercules Turbine Water Wheels.

POWER TRANSMISSION
.....MACHINERY.....

TURNED STEEL SHAFTING,
COUPLINGS, HANGERS, PULLEYS,
FRICTION PULLEYS AND COUPLINGS,
ROPE SHEAVES,
BELT TIGHTENERS,
GEARS, FIRE PUMPS, ETC., ETC.

73—74

MECHANICAL DRAFT FANS.

Blowers and "Fan System" of Heating.

"DAVIDSON" VENTILATING FANS.

Our Apparatus appeals with irresistible force to those who appreciate perfection of Detail, Exactness, Simplicity and Reliability. . . . . . .

Massachusetts Fan Co.,

Manufacturers and Engineers,

WALTHAM, - - MASS.

73—74

POWER ECONOMY

WITH

The Oil that Lubricates Most.

VACUUM OIL COMPANY,

NEW ENGLAND BRANCHES:

101 MILK STREET,

BOSTON.

73—74

W. B. SMITH WHALEY & CO.,

Mechanical and Mill Engineers and Mill Architects.

Plans, Specifications and Superintendence for Construction and Equipment of Textile Mills, General Industrial Plants, Electric Power Stations, Etc. Water Power Surveys, Estimates and Plans.

OUR SPECIALTY: *Electric Power Transmission and Electrically Driven Mills. . . .*

1328 Main St., COLUMBIA, S. C.

1012 Tremont Building, BOSTON, MASS.

73—74

Plymouth Cordage Co. North Plymouth, Mass.

G. F. HOLMES, Treas.

MANUFACTURE FINEST QUALITY

ROPES AND BINDER TWINES OF ALL DESCRIPTIONS.

THE RAW MATERIAL

THE FINISHED PRODUCT

BALE ROPE is one of our SPECIALTIES. We are LEADERS in Strictly First Class TRANSMISSION ROPE.

☞Send for our Booklet "Manila Rope Transmission." It may be of interest and value to you.

The Nernst Lamp

The Greatest Advance in Electric Lighting.

Especially suitable for the Lighting of Cotton or other Textile Mills for the following reasons:

1st. It is the only Lamp which gives the true value of colors.

2nd. It casts no shadows and does not flicker.

3rd. It evenly distributes a soft, white, uniform light, the same as daylight.

4th. It is absolutely free from fire risk, being entirely enclosed.

5th. It costs fifty per cent. less to operate as compared with incandescents.

6th. It enables the operative to do better and more efficient work.

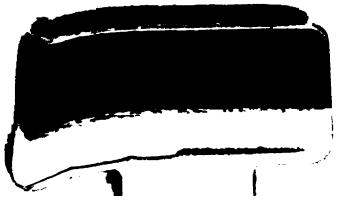
Electrical Supply Dealers

Will give full information concerning other special qualifications.

Or write nearest Sales Office for Illustrated Booklet.

Nernst Lamp Co.

Sales Offices; New York, 120 Broadway; Boston, 131 State St.; Philadelphia, 202 Real Estate Trust Building; Pittsburgh, Pa, Fayette St. and Garrison Place.

UNIV. OF MICH.
AUG 9 1909

UNIVERSITY OF MICHIGAN
3 9015 06717 4527